A REPORT OF THE

NATIONAL SCIENCE TALENT SEARCH EXAMINATION

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FOREWORD

This is the fifth report on the National Science Talent Search Examination, which was conducted in January, 1967. 6159 students appeared at this examination, 1145 were called for interview and finally 368 were selected for the award.

In the present report, Dr. K. N. Saxena, Field Adviser in the Department has analysed the data systematically and has interpreted the same giving rise to some important issues which will be of interest to the research workers, educationists, teachers and psychometricians. The report contains some important items like the accelerated programme of education for the awardees; parallel schemes in India and abroad; item analysis of the Science Aptitude Test; suggested areas for further research and allied problems etc.

The report also contains the designs of some research studies conducted on the data available on National level. The findings of these studies will be valuable to the educationists, teachers and research workers.

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PREFACE

This is the fifth report on the National Science Talent Search Scheme, sponsored by the National Council of Educational Research and Training. The present report incorporates many salient features like research projects and their interpretation ; statistical analyses conducted on the National data ; organisation of intensive follow-up programme ; sample items from parallel tests from other countries ; implications of the research findings in the overall development of science teaching in the country.

It is hoped that this report will be of interest to the teachers, educationists, scientists, educational administrators and research workers, who are actively engaged in the task of building the Nation.

I am grateful to Dr. R. K. Mathur of the Department of Psychological Foundations, N.C.E.R.T and Shri S. K. Batra Senior Statistical Associate of my own Department for helping me in the preparation of this report.

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CONTENTS

CHAPTER—I

A NATIONAL EFFORT TO SPOT AND NURTURE SCIENTIFIC TALENT

1.1 Introduction

The National Science Talent Search Scheme was started as a pilot project in the territory of Delhi in 1963 with the clear-out objective of identifying brilliant students at the end of the secondary stage of education so that their talents may be nurtured in a suitable manner in order that we may have a band of future scientists in the country, by the country and for the country.

This Scheme was started in response to the traditional question of brain drain. The current impact of science and technology on the daily life and on the process of National Reconstruction has made it almost imperative that we should identify a team of bright scientific and technical personnel to meet this perennial challenge With the growing demand for the basic scientific and technological research, it is considered necessary by educational planners and thinkers that vocational placements to the multitude of vacancies for specialists should be filled in such a way that we may have square pegs into square holes and round pegs into round holes. This leads us to a very important and difficult job of planning the entire technological and scientific education very carefully.

The age-old belief that scientists are born once in a while has been refuted by innumerable researches conducted in different parts of the world. There is a growing feeling that, being given a suitable mental make up, it should not be difficult to accelerate the environmental circumstances in such a way as to nurture scientific potential in a pre-designed fashion. This hypothesis requires that we should be able to identify future scientists at an early age and then give them such scientfic training as may help them to grow their intellectual capacities to the best possible extent. Hence the modern concept is that the environment has to play a very important role in creating scientists of eminence. This is true in other academic and vocational spheres also. Many people believe that aptitudes have some aspects hidden in the hereditary factors, while experiments have proved that aptitudes are not in-born but are the results of the environmental factors.

Educational psychologists and guidance workers have indicated that by the end of the higher secondary stage of education, there are ample chances that the specific aptitudes get matured as against the innumerable interests that germinate during this period of childhood and adolescence. Hence it was considered necessary that a search for scientific talent should be made at the end of

the higher secondary stage of education or its equivalent grade. By doing this, one can easily mould the scientific environment so that the group of high achievers, selected at the end of this stage, may find it congenial to develop their mental abilities and specific aptitudes concretely.

1.2 Some salient features of The National Science Talent Search Scheme : Having framed the hypothesis that it is possible to nurture scientific talent in such a way that we may produce future scientists of eminence, the Science Talent Search Scheme was extended all over the country in 1964. An All India examination was held which consisted of a Science Aptitude test, an essay paper, a project report and an interview. In 1966, the Scheme was revised and was given a National stature. From this year, the period of scholarship was extended to 9 years i.e. from B.Sc. upto Ph.D (instead of 3 years of degree course, as was contemplated in 1964). A maximum of 350 scholars are selected each year, commencing from 1964, and an examination is held annually on the first Sunday in the month of January. From 1966, the items regarding the placement of scholars and the appointment of individual guides has also been taken up in order to provide first rate scientific environment to the awardees. Institutions, having excellent academic background, are selected annually and the students are asked to choose one of the selected institutions for their admission for the degree, master's and doctorate level courses. The role of summer schools, for giving the awardees a congenial academic atmosphere, has also been emphasized right from the beginning of the Scheme.

With the intensive programme of selection, placement and follow-up, it seems optimistic that the identification and nurturing process will go a long way in making this National Scheme a success. This will, in its own turn, provide the Nation with a band of devoted scientists and teachers of science in the coming few years. The details of the process of selection and the follow-up programme are given elsewhere in this report.

1.3 Objectives of the scheme : The main objectives of the Scheme are :

1. to identify boys and girls at the close of secondary stage, who possess a marked aptitude for science;

2. to stimulate scientific talent by a competitive process and recognition of merit;

3. to help such students to pursue courses in basic sciences by the award of scholarship from B.Sc. to Ph.D. stage;

4. to provide special programmes in science to such scholars with a view to nurture the talent in the best possible way;

5. to encourage schools to take more active interest in the search for scientific ability and;

6. to help in building up a body of future scientists who will contribute to the scientific advancement, both in pure and applied fields.

1.4 **Other Outcomes of the Scheme**: Certain other outcomes are also expected to emerge out of this programme, the most important of which are :

* to create consciousness amongst educationists for improving the school syllabi pertaining to science subjects, methods of teaching and evaluation techniques;
* to provide colleges, universities and technical institutions with a means of contacting science students of high ability ;
* to mobilise the interest and support of higher centres of learning and other science agencies for the development of scientific talents.

1.5 **Abilities and skills to be tested** : The programme seeks to assess the pupil's :

* aptitude for science;
* powers of scientific reasoning and skill in scientific experimentation;
* ability to apply knowledge and to analyse and interpret scientific data;
* ability to express scientific concepts clearly and precisely;
* creativeness and mental alertness in the investigation of the scientific phenomena;
* awareness about the basic nature of science;
* knowledge about the recent developments in the various branches of pure and applied sciences, and
* skill to devise and develop some original ideas experimentally.

From the above descriptions, it will be clear that the National Science Talent Search Scheme has been designed to fulfil some important needs of the country i. e. to provide basic scientists to the various National Laboratories, Defence Establishments, universities and allied institutions. It is also hoped that the industries will be able to receive good quality of scientists for their own establishments.

Building up our educational structure on the findings of this Scheme, it seems necessary to point out that the selected scholars may do better in case

the educational studies at the university level are slightly modified to suit the intellectual capacities and aptitudes of the high achievers. This will include the setting up of separate institutions for the talented scholars. The follow-up studies have indicated that the mere placement of the awardees in selected institutions does not solve the problem of providing a suitable and challenging academic environment to the scholars. This is because of the undue emphasis on rote memorisation of the subject matter under the traditional system and therefore little scope is left for the creative abilities to be made use of during the period of study.

CHAPTER II

THE SELECTION PROCESS

2.1. **The technique of selection:** The selection procedure, as adopted during this year, was the same as in the previous years. Initial screening and the final selection were based on the:

(i) marks obtained in science subjects in class X or an equivalent (considering the higher secondary system);

(ii) marks obtained in the three theory papers:

(a) the Science Aptitude Test

(b) the Essay paper

(c) the Project Report.

(iii) marks secured at the final interview.

The number of students who appeared at the annual test, those who called for interview and those who were finally selected gave a selection ratio of 17 : 3 : 1.

2.2 **The cut-off point of the first stage screening:** On the basis of the previous experience, it was found that the probability that a student with a score less than 55% in science subjects at the high school stage will compete successfully in the final selection is less than 5% and hence it was decided that 55% should be the appropriate cut-off point. This also helps in making the number of students for the written tests within reasonable limits of financial and administrative control. Some investigations have been conducted on this cut-off point which will throw more light on the effectiveness of the first stage of screening.

2.3. **The science aptitude Test:** This test is framed in such a way that it helps to discover the pupil's aptitude for science.

* his/her interest of pursuing science beyond the routine curriculum;
* his/her powers of scientific reasoning;
* his/her ability to understand scientific concepts precisely;
* his/her ability to use the scientific approach in checking hypotheses and interpreting data and in applying principles, and
* his/her capacity to judge assumptions and underlying conclusions.

The questions in 1967 test were divided into two parts i. e. A & B. Part A was compulsory and Part B was optional. The compulsory part consisted of 75 thought type questions on fourteen different areas of sciences viz., Physics,

Chemistry, Mathematics, Zoology, Botany, Astronomy, Physiology and Hygiene, Engineering, Bio-Physics and Meteorology. Part B consisted of four sections viz., Physics, Chemistry, Mathematics and Biology. Each section consisted of 50 questions, out of which 30 questions were of factual type and 20 were of thought.type. The entire test was of three hours' duration and consisted of only multiple choice items of factual and thought types. The students were expected to answer all the questions in part A and the 50 questions from any one of the four sections provided in part B. Taking into account the wide spectrum of knowledge involved, the students were expected to have scientific comprehension of a higher nature as against their routine curricular knowledge.

The number of thought type items in the whole test were 56% while that of factual type were 44% whereas in one's own attempt this number is 76% for the thought type and 24% for the factual type questions. This specific ratio was kept so that the test may be used for identifying not only factual knowledge but also powers of comprehension, reasoning, critical thinking and analysis-synthesis of the examinees. The items in each of the major areas were set by a panel of three setters drawn from universities and Centres of Advanced Studies. The pooled items in a particular area were than scrutinised by another expert in that very branch of knowledge. Because of the peculiarity of the objective type test items, the finally approved items were again modified at the Department of Science Education, N. C. E. R. T. in order that a test of quality may be set.

Some sample items from the Science Aptitude Test 1967 are included in Appendix II. The scoring of this test was very simple because every correct answer carried one mark. Since, in such a test of objective type there is an element of guessing and hence a correction formula was applied as given below :

$$S = R - \frac{W}{N-1}$$

Where S=number of corrected scores,

R=number of right answers,

W=number of wrong answers, and

N=number of total alternatives provided in each item i.e. four in the present test.

The reliability and validity of the test indicate that it is possible to use an objective type criteria for spotting the scientific talent. The distractors employed for the framing of multiple choice items were made as plausible as possible. A research study with regard to this issue has been included in Appendix XX.

2.4 Essay Type Test : There is a school of thought which believes that the objective type of items cannot measure adequately the powers of comprehension,

organisation of thoughts and aboveall ability to express the scientific thoughts in words. The age-old traditional tool of evaluation of essay type was also made use of in the present evaluative process with certain modifications. In this test, four titles were given and each student was required to write an essay on any one of the topics in about 2,000 words. The titles were chosen in such a way that they may cover some of the modern developments in basic sciences. The sample topics for 1967 have been included in Appendix III to give an idea about the nature of the questions asked.

2.5 The Project Report : Every participating candidate was required to submit a written project report on a scientific topic to be chosen by him/her. The project reports were either to be based on experiments carried out by the students on scientific topics or on observational data, its systematic analysis and interpretation. Through the reports, originality and scientific creativity of the students was to be judged. The students were given the choice of taking necessary guidance from their teachers for the completion of such a report.

Some of the written project reports of 1964, 65, 66 and 67 have been published by the Department of Science Education so that these may provide guide-lines to the future examinees. Some of the teachers in the remote corners of India could also develop an insight with regard to this matter with the help of these printed project reports. Although many reports were of a routine nature, yet some indicated a high level of proficiency on the part of the examinees. One such report is included in Appendix IV.

2.6. The Interviews : On the basis of the written tests, 1145 students where called for interview at Delhi, Dehradun, Bangalore, Bombay and Calcutta. The composition of the different boards is given below :

Composition of The Delhi Board

Venue :	University Grants Commission, Bahadur Shah Zaffar Marg, New Delhi.
Dates of Interview :	8th May, 1967 to 13th May, 1967
1. Chairman :	Dr. D. S. Kothari, Chairman, University Grants Commission, New Delhi.
2. Member Secretary :	(i) Dr. R. N. Rai, Head of the Department of Science Education, N. I. E. Buildings, Mehrauli Road, New Delhi-16 (from 8th May to 10th May, 1967)

(ii) Shri N. K. Sanyal. Field Adviser, Department of Science Education, N.I.E. Buildings, Mehrauli Road, New Delhi-16, (from 11th May to 13th May, 1967)

3. Expert Members :

(i) Dr M.R.N. Prasad, Professor, Department of Zoology, Delhi University, Delhi (8th May to 10th May, 1967)

(ii) Dr. C.M.S. Dass, Professor, Department of Zoology, Delhi University, Delhi. (11th May to 13th May, 1967)

4. State Representatives :

(i) Shri P.D. Gupta, Ramjas College, Delhi (Delhi State)

(ii) No intimation in respect of Rajasthan State was received.

Composition of the Bangalore Board

Venue :	Institute of Science Bangalore.
Dates of Interview :	17th May to 21st May, 1967
1. Chairman :	Dr. P. L. Bhatnagars, Professor of Applied Mathematics Indian Institute of Science Bangalore-12.
2. Member Secretary :	Dr. K.N. Saxena, Field Adviser, Deptt. of Science Education N.I.E. Buildings, Mehrauli Road, New Delhi-16.
3. Expert Members :	Dr. K. Srinivasan, Head of the Chemistry Department, St. Josph's College, Bangalore.
4. State Representatives :	1. Shri N. Ramalingam, Chief Professor of Zoology, Presidency College, Madras (Madras State)

2. Shri T.V. Thimme Gowda,
   Joint Director of Public Instruction, Mysore (Mysore State)
3. No intimation in respect of Kerala was received.
4. No intimation in respect of Andhra Pradesh Government was received.
5. No intimation in respect of Pondicherry was received.

Composition of the Bombay Board

Venue : Institute of Science, Bombay.

Dates of Interview : 17th May to 21st May, 1967.

1. Chairman : Professor B.V. Thosar, Dean,
   Faculty of Physics,
   Tata Institute of Fundamental Research,
   Homi Bhabha Road, Colaba, Bombay.

2. Member Secretary : Dr. R. N. Rai,
   Head of the Department of Science Education,
   N I E. Buildings, Mehrauli Road,
   New Delhi-16.

3. Expert Member : Dr. J. J. Chinoy,
   Head of the Department of Botany,
   Gujarat University, Ahmedabad.

4. State Representatives :
   1. Shri J. B. Sandil, Principal,
      D.K.V. College, Jamnagar, (Gujarat)
   2. Shri H.D. Gupta,
      Assistant Director of Education and Incharge Science Consultant to Director of Education, Bhopal (M.P.).
   3. Dr. J. R. Merchant, Professor of Organic Chemistry, Institute of Science, Bombay (Maharashtra)
   4. No representative was deputed from Goa.

Composition of the Calcutta Board

Venue : Saha Institute of Nuclear Physics,
92, Upper Circular Road, Calcutta.

Dates of Interview : 17th May to 21st May, 1967.

1. Chairman :	Dr. B.D. Nagchaudhuri, Director, Saha Institute of Nuclear Physics, 92, Upper Circular Road, Calcutta-9.
2. Member Secretary :	Dr. M.C. Pant, Professor, Department of Science Education, N.I.E. Buildings, Mehrauli Road, New Delhi-16.
3. Expert Member :	Prof. R. P. Roy, College of Science, Patna.
4 State Representatives :	1. Dr. Sushil Chandra Das Gupta, Head of Mathematics Department, Bengal Engineering College, Shibpur (Howrah) (West Bengal)
	2. No Intimation in respect of Assam was received
	3. No intimation in respect of Bihar was received
	4. Shri Sankarsan Mohapatra, Reader in Mathematics, Ravenshaw College, Cuttack (Orissa)
	5. Shri D.L. Mukherjee, Head of the Chemistry Deptt., D. M. College, Imphal (Manipur)
	6. Shri Subodh Chandra Chakraborty, Senior Lecturer, Incharge of Physics Department, M.B.B. College, Agartala (Tripura)
	7. No intimation was received (Nagaland)
	8. N.E.F.A. No intimation was received
	9. No intimation was received (Andaman & Nicobar)

Composition of the Dehradun Board

Venue :	Doon School, Dehradun. (U.P.)
Dates of Interview :	27th May to 31st May, 1967.
1. Chairman :	Professor P. N. Mehra, Head of the Botany Deptt., Punjab University, Chandigarh.

2. Member Secretary :	Shri Ved Ratna, Lecturer, Deptt. of Science Education, N.I.E. Buildings, Mehrauli Road, New Delhi-16.
3. Expert Member :	Dr. R. C. Kapoor, Dean, Faculty of Science, Jodhpur University, Jodhpur
4. State Representative	1. Shri K. C. Sachdev, Principal, Govt. Degree College, Rampur, Bushahr, Distt. Mahasu (Himachal Pradesh) 2. No intimation in respect of Punjab was received. 3. No intimation in respect of Haryana was received. 4. No intimation in respect of J. & K. was received 5. Dr. Sitawar Sasan, Director of State Institute of Science Education, Allahabad (U.P.) 6. Shri R Saran, Assistant Director of Education, Delhi (Delhi).

While awarding the overall marks, the performance of each candidate was judged on his/her scientific approach towards problem solving and the practical applications of scientific phenomena Every student was given a fair chance to display his/her academic excellence The following table indicates the States and the Territories represented at each of the five boards ;

S. No.	*Venue of the Board*	*State/Territory represented*
1.	Delhi	Delhi & Rajasthan
2.	Dehradun	U P , Punjab, J & K and H P
3	Bangalore	A P , Punjab, Madras, Kerala and Pondicherry
4	Calcutta	West Bengal, Assam, Bihar, Tripura, Manipur, Nagaland
5.	Bombay	M P , Maharashtra, Gujarat and Goa.

The allocation of the States/Territories to the various interview boards was done according to administrative facility and the number of candidates from the nearby areas. Wherever possible, lodging arrangements were made for the students who came from outside stations.

CHAPTER III

SELECTION RESULT

3.1 **The Merit List**: An analysis of the merit list indicates that the maximum number of students were selected from the territory of Delhi. In all, 863 students appeared at the examination from this territory and out of this number 124 students were selected for the award of scholarship. In West Bengal, 519 appeared at the test and 79 were finally selected. Next in order of merit was U.P., where 944 appeared at the test and 32 were selected. In Kerala, 386 students appeared at the test and 27 were finally selected. The number of awardees selected from Assam, Orissa, Punjab, Rajasthan, Gujarat were on the very low side e g 2/82, 2/70, 3/115, 1/243, 5/79. From the State of Jammu and Kashmir, the result for the past year as well as for this year has not been very satisfactory because no student has been selected either in 1966 or 1967. The number of students who appeared were 11 and 29 respectively. With regard to the Union Territories, the result has not been alarming as compared to other States. In all 89 students appeared at the test and four were finally selected for the award of scholarship.

3.2. **The Value of Scholarship**: Prior to 1966, the duration of scholarship was for three years i.e. at Bachelor's level only. From 1966, it was decided that the rate of scholarship should be increased and the period should also be extended so as to cover the entire educational range from B. Sc. first year upto the end of the doctorate level. The revised scholarship rates were as follows : –

Rs. 100/-P. M. in the three years of B Sc.
Rs. 250/-P. M. in the two years of M.Sc.
Rs. 350/-P. M. for the doctorate level work (for a period of four years)

In addition to this, the awardees were also given the opportunity of purchasing books worth Rs. 100/-at the under-graduate stage; Rs. 200/- at the Master's level and Rs. 350/- at the doctorate level. The revised scheme also included the selection of 'some outstanding institutions in India where the awardees could be admitted at the Bachelor's Master's, and the doctorate levels. In addition to this placement, they were also required to be attached to senior teachers in the concerned faculties, who could give personal guidance to the awardees. The students who were required to join the selected institutions outside their home towns, were expected to live in an approved hostel so that the overall education did not suffer. This complete change in the conditions of the award brought forth a new life to the Scheme because it was now clear that every awardee has the option of starting his/her education from B.Sc. first year and

continue the same upto the end of the doctorate level, provided he/she secured a first class at the end of the Bachelor's and Master's degrees. Secondly, the inter-personal relationship between the scholars and the teachers was expected to bring about better education both from the content point of view and from the point of view of the development of the overall personality.

3.3 **Follow-up of the awardees:** Detailed cumulative record card in respect of each of the awardee was prepared in order that it may incorporate the essential bio-data, academic progress and other extra curricular details. These record cards have proved to be one of the important tools of the follow-up programme. It will not be out of place to mention that very often relevant details are not easily available inspite of the best efforts because of many obvious reasons.

One of the most important follow-up programmes is the organisation of summer schools. This year 15 summer schools were held at Bangalore, Chandigarh, New Delhi, Udaipur, Calcutta, Bombay, Poona, Delhi, Kanpur, Varanasi and Madras.

The two main objectives of the summer schools were: (a) to establish inter-personal relationship between the teachers and the taughts (b) to motivate the experimental curiosity of the scholars so that they may utilise their potentialities to their best advantage. At most of these summer schools project work was considered to be a very important aspect for bringing about better education on lines of creativity and scientific experimentation. In addition to the above objectives, the participants were also introduced to the new devlopments in the various fields of basic sciences. This type of exposure is very limited under a routine scholastic situation, existing at most of the institutions of higher learning.

3.4 **Proposals for the Qualitative Improvement of the Scheme:** In order that improvements may be brought about in the process of selection, placement and follow up, some research projects have been suggested in Appendix XII. Out of these, some projects have already been undertaken by the Department of Science Education and some of the findings of the research studies have been quoted in Appendix XX. It may be mentioned that constant research is needed to bring about needed improvements in the overall functioning of this Scheme. The validity and the reliability of the Science Aptitude Test have been determined, which gives a ray of hope that the suitable test items can easily be made use of by the Central and State Boards of Education and Examination. In fact some authorities have already made use of these items for diagnostic and prognostic purposes.

CHAPTER IV

ACCELERATED PROGRAMME FOR THE AWARDEES

4.1 A high achiever as the future scientist : The problem of educating the talented students in science, giving needful incentives and purposeful motivational situations, is of a perennial nature from times immemorial and hence needs to be studied with full confidence and proper weightage. Only then the channelisation of the energy of the bright scholars can be put on a firm ground of an utilitarian nature. It is a fact that the high achievers need a suitable academic atmosphere where they can attach sufficient weightage to their creative abilities. At the same time it has been a painful experience that in the present system of traditional education, there is hardly any scope for the creativity and intellectual excellence. Therefore, it seems to be very necessary to provide an accelerated type of environment to the high achievers in and out of school/college atmosphere. The problem of providing challenging opportunities of a creative nature is not so acute at the school stage but it assumes a wide dimension when it is a question of providing an accelerated environment to the high achievers at the college/university level. There are many problems associated with this issue and some of them have been discussed in the next paragraph.

4.2 Possible Alternatives : The first solution is to have special classes for the educationally gifted students after the routine classroom work. At these special classes, an effort can be made to devise accelerated types of courses for the scholars and then to enter into prolonged type of grouped discussions.

The second alternative is to pursue a parallel syllabus for the high achievers. This will mean a type of classification of pupils.

The third solution is to give the talented students intensive coaching during the holidays and summer vacations. The organisation of summer schools for the talented scholars has been very successful for motivating them to do initial research work alongside their usual academic work of a curricular nature.

The fourth solution is to set up separate institutions for the academically bright so that a new type of extensive curriculum and modern methods of evaluation can be followed without any difficulty. Recent thinking in all the developed countries of the world, including a socialistic country like Soviet Union, has led to the setting up of special institutions catering to the needs of the bright scholars. This suggestion is engaging the active attention of some of the educational planners and thinkers of our country also and hence needs to be pursued with greater conviction.

4.3 The Follow up of the Accelerated Programme for the High Achievers: The recent trends in the follow-up programme of the National Science Talent Search Scheme have indicated that the awardees be given a congenial and an accelerated educational environment in order that they may derive full utility of their intellectual capacities. The follow-up programmes will, therefore, be useful only when they are evaluated from time to time. One such programme is the provision of an intensive placement schedule, where the awardees are required to get admission in selected institutions of a higher nature, specially the Centres of Advanced Studies. The appointment of individual guides to the scholars is also one of the important follow-up programmes directed towards accelerated type of scientific education. The organisation of summer schools for a longer duration also seems to be an important issue which should be given considerable thought.

The various types of follow-up programmes, including excursions to places of scientific interest, group discussions, lectures by eminent scientists etc. need to be followed up with regard to their efficacy.

It is hoped that the appointment of individual guides, placement of awardees, the organisation of the summer schools and allied steps will go a long way to motivate the scholars to a very great extent. The opening of separate institution for the talented scholars has to be scrutinised with greater attention and enthusiasm.

CHAPTER V

SAMPLE ITEMS OF THE SCIENCE APTITUDE TEST FROM INDIA AND ABROAD

5.1 Parallel Schemes in U.S.S.R., U.S.A. and other countries : A mention has already been made about parallel schemes in India and abroad in the preceding Annual Reports. The Westing House Science Talent Search Scheme of the United States as well as the Mathematical Olympiads of the Soviet Union are the nearest schemes to the National Science Talent Search Scheme and a detailed mention of the two schemes has already made in the previous reports. The Science Aptitude Test used under the present scheme is very much similar to the Westing House Science Aptitude Test and hence it will be worthwhile to mention some items from this scheme for the guidance of the research workers and teachers of science.

5.2 Sample items from the Westing House Science Aptitude test

PART A

Directions : Each question has five possible answers, but there may be as many as five right answers for a question. For some questions there will be only one right answer, while others may have two, three, four or five right answers. Put an X in the parentheses corresponding to each right answer. Your score is the number of answers market correctly plus two times the number of questions answered entirely correctly.

1. Of the following planets, which one is the smallest ?

   1. Earth
   2. Jupiter
   3. Mars
   4. Mercury
   5. Venus

2. Which of the following is (are) true of insects ?

   1. All legs are attached to the thorax.
   2. Insects have antennae attached to their heads.
   3. Insects have six legs.
   4. Insects have two compound eyes.
   5. The body of an insect is divided into three parts : head, thorax and abdomen.

3. New findings from measurements made of earth-circling satellites give information about theearth's shape. Which of the following is (are) NOT true ?

1. It bulges at the equator.
2. It has four high points, giving it roughly a pyramid shape.
3. It is narrower at the equator, wider at latitudes 60°N and 60°S and flatter at the poles than a sphere.
4. It is slightly pear-shaped with the narrow end in the Arctic.
5. The earth's equator is egg-shaped, not circular.

4. Element 96, created by the bombardment of uranium 238 and plutonium 239 with high energy ions or alpha particles in a cyclotron, was named

1. americium
2. berkelium
3. californium
4. currium
5. transuranus

5. Which of the following is (are) true of the new field of observational neutrino astronomy ?

1. It cannot properly be classified as a branch of astronomy.
2. It is based on the weak interaction property of the neutron.
3. It will enable astronomers to see the surface of Venus.
4. It will enable scientists to obtain information directly from the interior of a star.
5. It will provide improved estimates of the average energy density in the universe.

6. Pauli's exclusion principle

1. is basic to our understanding of the electron structure of the atom ;
2. is important in understanding the gravitational forces within a solar system;
3. is the basis of non-Mendelian genetics ;
4. states that a star cannot simultaneously generate energy by gravitational contraction and by hydrogen fusion
5. States that no two particles of the same kind in the same atom can be in the same quantum state.

7. The study of the flow of materials, particularly plastic flow of solids and the flow of non-Newtonian liquids, is called

1. dynamics
2. hydraulics
3. piezoelectric phenomena
4. rheology
5. stress

8. Which of these birds is (are) now extinct?

1. horned owl
2. kiwi
3. moa
4. takahe
5. whooping crane

9. One astrophysical theory requires that to call a celestial object a star, its mass must be more than 7% that of the sun. Which of the following statements support (s) the theory ?

   1. A minimum magnitude of 7 is required.
   2. Anything smaller than this cannot emit energy by nuclear processes, but only by reflected light.
   3. A smaller body would have insufficient gravitational attraction to hold a solar system in orbit.
   4. The required mass is smaller than that observed for any celestial object in the Milky Way galaxy.
   5. The required mass is the smallest observed for any " sun".

10. Which of the following identifications of vitamins is (are), correct ?

   1. A : thiamine
   2. B_1 : folic acid
   3. B_2 : riboflavin
   4. B_{12} : tocopherol
   5. C : ascorbic acid

11. A number that is not a root of any equation (linear, quadratic, or of higher degree) whose co-efficients are integers (positive or negative whole numbers or zero) is

   1. imaginary
   2. indefinite
   3. transcendental
   4. transfinite
   5. transformed

12. The transistor was first announced in

   1. 1933
   2. 1938
   3. 1943
   4. 1948
   5. 1953

13. Phloem is found in

   1. blood
   2. computer circuits
   3. respiratory tracts
   4. smooth muscle fibers
   5. trees

14. Each pair of answers consists of the common name of a group of animals and the name of a phylum. Which pairing (s) is (are) correct ?

1. crustaceans : Arthropoda
2. flat worms : Annelida
3. round worms : Nemathelminthes
4. single-celled animals : Coelenterata
5. sponges : Porifera

15. Calcium

1. freezes at 48° C,
2. has a greater specific gravity than lead,
3. is an alkaline earth metal,
4. is harder than lead,
5. occurs in nature as the free metal

16. A warm-blooded animal in hibernation

1. does not breathe,
2. has a heart rate of 1-15 beats per minute,
3. has the same body temperature as surrounding air,
4. maintains a normal blood pressure,
5. may be frozen and than thawed without damage.

17. A plant growth hormone is

1. a catalyst
2. an auxin
3. an enzyme
4 another term for fertilizer
5. produced in meristematic tissues :

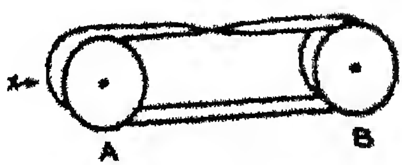
PART B

Directions : in part B, the questions and answers following each section are based on the information given. Each question has five possible answers, BUT there may be as many as five right answers for a question. For some questions there will be only one right answer, while others may have two, three, four or five right answers. Put an X in the answer box corresponding to each right answer. Your score will be the number of answers marked correctly plus two times the number of question for which you have marked all the correct answers and no other answers.

4

SECTION A

Two pulleys A and B, are each 20 inches in diameter. The belt is [illegible] feet long and is positioned as shown in the diagram



Questions on Section A

18. How many rotations will pulley A make as the belt makes one complete circuit ?

    1. 360/20π
    2. 600/20π
    3. 360/10π
    4. 360/100π
    5. The arrangement prevents motion of belt and pulleys

19. If pulley B turns in a clockwise direction, pulley A

    1. cannot turn because of the arrangement of the belt .
    2. will rotate at half the speed of pulley B .
    3. will rotate at the same speed as pulley B .
    4. will turn in a clockwise direction ;
    5. will turn in a counterclockwise direction

20. A point X is marked on the outside of the belt at the point shown in the diagram. In how many rotations (counterclockwise) of the belt will the X again be in that same position ?

    1. 1
    2. 2
    3. 3
    4. 4
    5. The system will not permit rotation.

Section II

Dashiell found considerable improvement in performance due to audience affects on such tasks as simple multiplication on word association. But, as is the case in many other areas, negative audience effects were also found. Pessin asked college students to learn lists of nonsense syllables under two conditions, alone and in the presence of several spectators. When confronted an audience, his subjects required an average of 11.27 trials to learn a seven-item list. When working alone they needed only 9.85 trials. The average number of errors made in the "audience" condition was considerably higher than the number in the "alone" condition. Husband found that the presence of spectators interferes with the learning the finger maze. Later Pessin and Husband confirmed Husband's results. The number of trials which the isolated subjects required for learning the finger maze was 17.1. Subjects confronted with spectators, however, required 19.1 trials. The average number of errors for the isolated subjects was 33.7 ; the number for those working in the presence of an audience was 40.5.

The results thus seem to contradict one another. On a pursuit-rotor task Travis found that the presence of an audience improves performance. The learning of nonsense syllables and maze learning, however, seem to be inhibited by the presence of an audience, as shown by Passin's experiments. The picture is further complicated by the fact that Passin's subjects who tried to recall the lists in the presence of spectators did considerably better than those who tried to recall them.

Questions on Section II

20. In which studies was learning in the presence of other persons less efficient than learning without an audience ?

    1. Dashiell
    2. Husband
    3. Pessin and Husband
    4. Travis
    5. Triplett

21. What hypotheses were offered to account for the observed differences in learning of the different materials ?

    1. Cognitive learning is facilitated by the presence of an audience.
    2. Having an audience interferes with learning tasks requiring greater concentration or effort.
    3. No explanatory hypotheses were offered.
    4. The learning situation were to dissimilar to make comparisons.
    5. The results depend on whether rate of learning or recall is used to measure learning.

22. Which of the following statements is (are) consistent with the section?

1. A pursuit-rotor task was learned more effectively with spectators present.
2. Learning of nonsense syllables was inhibited by the presence of spectators
3. Maze learning was inhibited by the presence of spectators
4. Recall of nonsense syllables was better with spectators present
5. Social facilitation should be used to improve learning

Section III

In deep sea diving, oxygen toxicity may cause violent convulsions and eventually death. The safe limit for breathing 100% oxygen is two atmospheres absolute for one-half hour. If the pressure of a gas mixture is increased, then the percentage of oxygen must be decreased sufficiently in order to prevent oxygen toxicity, but not so much as to cause symptoms of oxygen lack (hypoxia). Our present operational limit of 180 feet for 30 minutes is based on the fact that a single gas mixture containing 16% oxygen is used for treatment of the bends to avoid the problems of hypoxia as the patient nears the surface and to promote the removal of the inert gas causing the bends. A depth of 180 feet of sea water is equivalent to 12 atmospheres, and one-sixth of that amount is equivalent to two atmospheres of oxygen. Again, we do not fully understand the basic mechanisms of oxygen toxicity at the cellular level. If this understanding can be reached, then perhaps suitable pharmacological agents can be developed to minimize oxygen toxicity and thereby allow for decompression treatments starting at much greater depths.

Questions on Section III

31. Bends are

1. associated with too high a proportion of oxygen in the breathing mixture;
2. caused by helium only;
3. caused by inert gases in the breathing mixture;
4. certain to occur after working and breathing in oxygen pressures greater than 12 atmospheres;
5. the same as hypoxia;

24. Which of the following statements is (are) subtantiated by the Section?

1. Extrapolation of the information given shows that a diver can operate safely at a depth of 760 feet using 4% oxygen is his gas mixture
2. Oxygen toxicity and bends not only have the same symptoms, but also the same physiological mechanisms.

3. Oxygen toxicity is a condition of more rapid oxidation within the cell than the cellular tissue can withstand.
4. The least oxygen safe for breathing is 16%.
5. Within the ranges of pressure and time indicated in the Section as safe limits, pressure of the gas mixture and proportion of oxygen are inversely related.

Section IV

A research scientist irradiated hybrid male mice for 12 weeks with various doses of neutron radiation. The animals lived during this time in cages on top of a graphic low-energy experimental pile, a neutron source.

After irradiation, the mice were mated with groups of female mice of a specific test stock, also used in radiation research. The male irradiated mice carried dominant genetic characteristics, such as coat colour, whereas the females carried recessive genetic characteristics that the offspring would inherit, such as pink eyes.

All the offspring of the mice were checked by the researchers to see if characteristics of permanent mutational change had occured. This was expressed, for example, as change of coat color from black to brown, spotting of coat, kinking of tail or body hair, change in size of ears or color of eyes, or abnormality of feet.

It was observed that after mating successive generations expressing mutations, when the dominant mutations of the irradiated male mice became doubled in an offspring, it nearly always caused death. The same was true when the recessive mutations were doubled. As an example of how seldom this happened, however, only about one mouse of each 2,000 carrying the dominant characteristics from the group of male mice irradiated with 200 rads of neutrons showed this lethal effect of dominant characteristics.

From these long-term irradiation exposure experiments it is not possible to predict effects of large doses in a short period of time. In another experiment, it was found that when the animals were given very high doses in just a few minutes instead of weeks, the number of mutations was much lower, being only about one-tenth of that produced by long-term exposures.

Questions on Section IV

25. Which of the following statements is (are) supported by the Section ?

1. Different kinds of radiation sources produced different mutations.
2. Long term exposure produced more mutations than shorter intensive radiation.

3. Most mutations were lethal
4. The genetic effects of equal radiation [illegible]
5. The results of the experiments [illegible] from experiments with fruit flies

26. Which of the following best expresses [illegible] of the study ?

    1. to compare mutation rates due to [illegible]
    2. to find the minimum radiation capable of producing mutation [illegible]
    3. to find the mutational potential of the male mouse
    4. to see if radiation of males only would produce [illegible]
    5. to test the fertility of irradiated male mice

Section V

Forces of attraction between molecules, [illegible] are adhesion and cohesion. These forces are essentially electrical. Adhesion [illegible] force between unlike particles (molecules or atoms) [illegible] between like particles. Thus fine dust and paint adhere to a smooth [illegible] the particles of a steel cable cohere together. Both adhesion and cohesion depend on temperature, cleanliness of adjoining surfaces, intimacy of contact, degree of pressure etc.

The constituent particles composing a body occupy positions determined by the principles of minimum potential energy. If an attempt is made to bring these particles closer together, an elastic tension is set up, resisting the compression. Conversely, if the particles are separated beyond their normal distance, forces of cohesion, opposing this separation, come into play. The same conditions govern the spacing of atoms or ions in the crystal lattice of a solid.

Two examples may be considered : A. A clean, circularly shaped glass plate, suspended at its centre by a spring, exhibits considerable adhesion when brought into contact with the surface of water. When finally separated from this surface, the plate emerges wet. B. If the same experiment is tried with mercury the glass plate, removable from the mercury surface only with considerable effort, is found to be dry.

Questions on Section V

27. According to example A :

    1. adhensive forces (water to glass) are greater for circular plates of glass than for square plates of glass having the same area;
    2. Cohesive forces have to be greater than adhesive forces in situations like example A;

3. Cohesive forces (water for water) follow Hooke's Law;
4. if the glass plate had been corrugated the adhesion would have been increased.
5. the force of adhesion of water to glass is greater than the cohesion of water for itself.

28. Considering example II :

1. adehsion between the glass plate and mercury is less than between the glass plate and water
2. adhesion between the glass plate and mercury is not as great as the cohesion between mercury particles.
3. a square glass plate of the same as the circular glass plate would exhibit less adhesion .
4. mercury shows no elasticity
5. wetness or dryness of glass plate is not pertinent to the example.

29. Which of the following statements may be correctly inferred from the Section ?

1. Adhesion and cohesion are magnetic phenomena.
2. Smooth surfaces are easier to keep dust-free than rough surfaces.
3. The greater the similarity in the physical properties of two substances, the greater the adhesion between them.
4. The greater the viscosities of two substances the less the adhesion between them.
5. The principle of minimum potential energy governs the spacing of ions or atoms in the crystal lattice of a solid.

Section VI

In the diagram

$a + b + c = u$

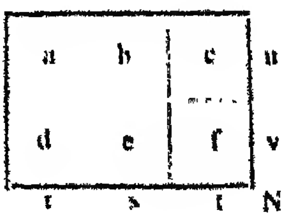
$d + e + f = v$

$a + d = r$

$b + e = s$

$c + f = t$

$r + s + t = u + v = N$



Each of the values, a, b, c, d, e, f, r, s, t, u, v and N is integral and positive.

Questions on Section VI

30. Which of the following sets of values taken one at a time make it possible to determine the value of f ?

    1. c, t
    2. d, e, N
    3. d, e, v
    4. r, s, N
    5. r, s, v

31. Which set (s) of values taken one at a time will enable one to determine each of the remaining values in the diagram, when r, s and t are known ?

    1. a, d, N
    2. a, e, f
    3. d, b, c
    4. d, e, v
    5. u, v

32. If the values of N, v, r and s are known, which additional set (s) of values will enable one to determine the value of c ?

    1. a only
    2. b only
    3. d only
    4. e only
    5. f only

33. If N, u, r and t are known, what is the smallest number of additional values one must know to determine each of the remaining values (a, b, c, d, e, f, s and v) in the diagram.

    1. 0
    2. 1
    3. 2
    4. 3
    5. 4

CHAPTER VI

INTER-PRETATION OF THE DATA

6.1 AREAWISE DISTRIBUTION OF ITEMS ON SCIENCE APTITUDE TEST :

On a perusal of Appendix (v), it will be clear that the number of items included in the Biology section were a little more as compared to the number of items included in Physics, Chemistry and Mathematics sections viz., 7 in each of the latter 3 sections while 9 in the Biology section. The other 9 branches of science had 5 questions each. Low weightage to the interdisciplinary branches of sciences is because these areas are not included in the curriculum of the Secondary Boards. The interdisciplinary branches were included because there was a general feeling that we should have an assessment of the broad spectrum of knowledge of the students The questions framed in these sections were of multiple-choice type arising out of thought provoking passages full of scientific information. Four alternatives were provided in each question. Thus, in all there were 75 thought type questions covered by 14 branches of science and, this constituted Part A (compulsory) of the test.

In Part B (optional) of the test, there were four sections, viz., Physics, Chemistry, Biology & Mathematics and these subjects are included in the curriculum of the Secondary Boards. An examinee was to choose one of the these four sections, depending upon his aptitude in a particular branch of basic science. Each of the four sections consisted of 30 factual type and 20 thought type questions. The questions were set in the multiple choice form with four alternatives to each question. Thus the Science Aptitude Test contained 56% of thought type items and 44% of the factual type items, whereas this figure is 76% and 24% in an examinee's attempt. The number of thought type items (76%) were slightly more than three times the number of factual type items (24%) because it was felt that the former type of items were more suitable to spot talented students. A perusal of Appendix XIV will make'it clear that 68% of the factual type items and 76% of the thought type items were selected on the basis of difficulty and discriminative values. The rejection of thought type items is slightly more this year as compared to the preceding year by 3% while in case of factual type items the rejection figure has increased by 10%. The increase in the rejected items of the factual type is because of their limited scope in eliciting higher and complex mental potentialities.

On the whole one can judge, empirically, with such objective type of test, the ability and interest in a particular branch of science of a student.

From the preceding year's figures it has been observed that the percentage of students who opt for Mathematics as an optional part of the test is much less than the option for the other optional parts of the test. It is a general feeling of the examinees that Mathematics part is more time consuming and difficult in comparison to other parts of the test. A research project [illegible] be taken up very soon to verify the aforesaid belief.

6.2 DISTRIBUTION OF THOUGHT TYPE ITEMS INCLUDED IN THE SCIENCE APTITUDE TEST :

Appendix VI indicates the various sections together with the number of passages and the number of items extracted from those passages under each area. The last column of appendix VI, gives the average number of the items per passage. There seems to be some variation amongst the paper setters in this respect. The number varies from 1.25 to 3.6. On an average the number of items per passage is 2.3 in the compulsory part of the test and in case of optional part this figure is 3.2. The variation explained above may be due to many reasons, like the readability of the passages from different subject areas, abstract nature of the subject matter etc. This may also be due to the fact that there are some areas where extraction of items (which can judge critical thinking and scientific reasoning together with the use of higher mental powers) is very difficult and hence the average number of items per passage for such areas is as low as 1.25 e.g. in Philosophy of Science and in agriculture. Mathematics and in some particular branches of science like Physics and Biology the culling of items is comparatively easier and that is why the average number of items per passage are 3.5, 3.6, and 3.[illegible]

6.3 ANALYSIS OF THE MERIT LIST :

In Appendix (VIII) the analysis of the merit list is given, taking six slabs of 50 ranks each and the last slab of 68 ranks (in order of merit) to indicate the educational courses opted by the awardees. Out of the top twenty awardees, 12 have joined basic science courses and only 6 have joined engineering courses. Amongst the first 50 students, 34 joined basic sciences, 10 joined engineering and technological courses and one opted for other professional courses. In the next slab of 50 awardees, 31 have opted for basic sciences and only 5 have gone in for engineering and technology. Thus of the top 100 talented students, 65% *have joined basic science courses while in the middle group 64% and 67% have joined in the third group of low students.* 19% of the students in the top group have joined engineering and other professional courses. This figure is 20% in the middle and 16% in the third group. In the last slab of 68, 54 have joined technical courses. From the above statistical data one can draw the conclusion against the statement "that top meritorious students are more likely to go in for engineering, techno-

logical or medical courses". Rather there seems to be a tendency for the brilliant students to opt for basic sciences in preference to the technological or medical courses.

On the whole, 68% students have joined basic sciences, while 17.4% have joined engineering or other professional courses. This bias in favour of basic science courses may be due to the specific aptitude of the students, facilities extended, and the pre-conditions laid down in the specific scholarship scheme as well as the pre-conditions of admission to the various institutions in the country.

6.4 STATE-WISE DISTRIBUTION OF THE EXAMINEES AND THE AWARDEES :

Appendix IX A (i) reveals that there is a wide variation amongst the States in respect of number of students taking the Science Talent Search Examination. This reflects that :

(1) the total number of students in class XI or an equivalent stage in different states is different ;

(2) publicity of the scheme in all the states might not have been uniform ; some States and Union Territories like U.P., M.P., W.B., Madras, M.S. and Delhi have sent an appreciable number of students to take these tests ;

(3) there may be a wide variation amongst the states and the territories with regard to the number of students with 55% marks in science subjects in class X (or an equivalent class) ;

(4) it is a fact that in some states the facilities for professional courses are so adequate as to accommodate most of the bright students, leaving very little incentive for them to go in for basic science courses.

Column (5) Appendix IX-A (i) gives the statewise selection ratio (in percentage) at the first stage of selection, viz., those eligible for being called for interview on the basis of marks obtained in theory papers.

It will be interesting to note that these selection ratios for the Delhi Territory and the States of W.B., Kerala and M.S. are higher than other States and Territories indicating that probably only those students were sent for the tests whowere high achievers. In the remaining states although a sizable number of students were recommended to take the test yet very few students were finally selected for the award, particularly in the states of Rajasthan, M.P. and A.P. This may be due to the fact that the recomended students had probably

not been able to show matching critical thinking and scientific comprehension as could have been expected on the basis of their academic achievement (as reflected by school marks). This indicates that :

(1) the scientific studies in these States have not been oriented to incorporate the recent developments in sciences .

(2) the school marks in these States reflect a rote memory knowledge rather than wide spectrum of scientific comprehension based on critical thinking and reasoning .

(3) the teaching in these states may be more oriented to prepare students for public examination demanding rote type of selective learning rather than developing scientific concepts, creativity and critical thinking ;

(4) the cut-off score of 55% reflects different standards of cognitive abilities in different states and territories .

(5) the system of examination is quite different in different states

A perusal of column (7) giving the final selection ratios, indicates slight ups and down in the relative position of the State's performance in comparison to their relative position in column (5). States like U.P., Gujrat and Bihar have shown some improvement in the final result in comparison to that of the previous year's result.

The plausible reasons for comparatively good performance from Delhi (in addition to those quoted above) may be that :

(1) the students in Delhi have an advantage over others in having better library and laboratory facilities in addition to better experimental methods of teaching ;

(2) the curriculum is comparatively rich in content matter ;

(3) there may be some familiarity with objective type tests amongst Delhi students because of the previous examinations of 1963, 64, 65 and 66 ; to compensate for this relative disadvantages of the students from other States, the Department of Science Education has sent copies of the test papers of previous years to all the states and territories so that the teachers and students may get an idea of the items that they can expect ;

(4) these students have added facilities of television lessons and well qualified science teachers, mostlypost-graduates ;

(5) these students are exposed to better extramural activities of a scientific nature.

Column No. 8 indicates the percentage distribution of the awardees in the different states. Most of the participating states and territories have received a few scholarships, although territory like Delhi has been taken a big chunk out of the total number. It may be noted that the awards were made on an All India basis and no state/territory quota was fixed. However, one feels that from the states like U.P., where the student population is quite large and much more than that in Delhi, a large percentage could have competed successfully in case their teaching and learning standards were comparable with those prevelent in Delhi.

A glance at Appendix IX-A (ii) reveals that states like Kerala, W.B., Bihar, A.P. have shown better results in comparison to that of the preceding years, while in case of states like Gujarat, U.P., Orissa, M.S., M.P., Assam, the number of selected candidates for the award has decreased. It is quite clear from the aforesaid Appendix that from the State of W.B. and territory of Delhi, a good number of students are selected for the award every year. In thes year 1966, from the Delhi territory maximum number of students (150 awardee out of a total of 354, finally selected) were selected. But the statewise selection ratio is only 26% which has been reduced to 14.36% in the year 1967. This is because, in the year 1966, better students (securing marks higher than the cut-off point) were recommended for the test and the total number was 572, while in the year 1967 the total number of examinees has increased to 863, whereas the number of students securing marks much above the cut-off point has been reduced. One may be inclined to feel that the chief plausible reason for comparatively good performance of the students appearing from Delhi Territory is that the students get maximum information relevant to the examination and some other allied facilities. In reality this is not so, because it has been observed, since the year 1964, that students just at the tail end of the list of students who qualify for the interview are found to possess a good grasp over the subject matter and the project work. This may be due to good educational background. Though more rigourous norms are adopted in the interview board at Delhi, still the average score of the candidates in the Interview is more than that of the average score in Interview of the students from other States.

A perusal of the Appendix IX B, showing language-wise distribution and the average marks scored by the examinees appearing from different states at the essay paper of the National Science Talent Search Examination year 1967, indicates that there is no marked tendency among the students to write their essay paper in Hindi (27.9%) as against in English, where this percentage is 48.3%. This represents a changed position from that of last year, where the %age of students writing the essay paper in Hindi was more than writing the

paper in English. Though the total number of examinees have increased from 3932 (in the year 1966) to 6049 in 1967, yet the total number of examinees from the Hindi speaking areas has gone down particularly in the case of M.P. and U.P. States.

It is interesting to note that in case of Hindi medium states, there is a growing tendency among the students of writing their essay paper in Hindi in comparison to the students from states with regional media writing their paper in their own regional language, such as Bengali, Tamil, Malyalam etc.

The figures are as follows :—

%age of students who wrote their essay paper in	States with Hindi medium	States with regional language as medium
(i) Hindi	79.1%	0.2%
(ii) English	19.2%	52.4%
(iii) Regional languages	1.7%	47.4%

The overall %age of the esssy paper written in English, Hindi and other regional languages is 48.3%, 27.9% and 23.80%, whereas the total number of students from Hindi speaking areas are much less than the total number of students appearing from the remaining states/territories.

Moreover, a comparative study has been performed between the average score scored by the examinees appearing from the Hindi speaking areas and the areas with regional languages as medium (the state of Mysore is excluded because of the fact that 74% of the examinees wrote their essay paper in English). The figures worked out are 18.76 : 20.72.

The language-wise average score of the examinees is given in the last row of the table. On a perusal of this table, we find that the average score scored by the examinees who wrote their paper in Assamese is highest i.e. 23.50 while in the preceding year the highest average score was in Tamil language. This should not be misinterpreted in terms of some special consideration to the Assamese language but may be due to the following reasons :

(1) better verbal facility of the examinees and adequate ability to organise ideas and their systematic representation;

(2) selected nature of the sample ;

(3) better academic achievement, irrespective of the language concerned.

A comparative study regarding the average score scored in the essay paper by the examinees appearing from the various states/territories is given in the last column of Appendix IX B. There is a significant variation amongst the average score obtained statewise, the range being 16.20 to 23.60.

6.5 INTER-BOARD VARIATONS IN THE DISTRIBUTION OF SCORES ON THE DIFFERENT TESTS :

Appendix (X-A) gives the mean, standard deviation and a measure of skewness of the scores, togetherwith their standard errors for each of the interview boards. It also gives the frequency distribution of scores board-wise and test-wise. The average score in Science Aptitude Test varies from 47.50 to 80.12, while the pooled mean is 77.50. It is interesting to note that this range is smaller than the range that existed in 1966. Barring Delhi and Calcutta Boards, the average scores on the rest of three boards are not much different from the pooled mean. The average score on essay paper and project report varies from 26.26 to 27.42 and 12 22 to 13.91, whereas their respective pooled means are 26.98 and 13.04. It has been observed that on the essay paper, the average scores on the five boards are almost homogeneous and in the distribution of scores on project report, the average scores for the different boards are again homogeneous.

However, with regard to the Interview scores, the average score varies from 15.57 to 28.06, while the pooled mean is 19.62, indicating a wide hetrogeneity of scores scored by the candidates at the various interview boards. The inter-regional variations can be attributed to the heterogeneity of various factors obviously present at the different interview boards. The average score at Dehradun Board is the highest while that at Bangalore is the lowest. The measure of skewness $\sqrt{\beta_1}=0.278$ in case of Dehradun Board is the lowest, indicating that the marking was not at all stiff. One of the reasons may be that the students interviewed at this Board may be of a higher calibre, which is incidentally supported by their average score in other theory papers. It is interesting to note that the standard deviation (S. D.) of the distribution of scores, scored by the candidates interviewed at this Board, in S.A.T., Project, Essay and Interview is comparatively lower as compared to the standared deviation (S. D.) of the distribution of scores at other Interview Boards, indicating that there is not much variation amongst the students at the abovesaid Board in respect of their scores in various tools of selection. Despite the fact that Delhi Board students have done well at the theory tests, they have recorded comparatively lower average score on the interview. From the measure of skewness $\sqrt{\beta_1} = 1.250$, it is clear that more rigorous norms were adopted at the aforesaid Board. Inspite of effective steps taken to structure the interview on sound lines and to increase the reliability of the interviews, not much benefit has come out except that the range has decreased and the minimum and the maximum scores have increased.

From the histograms B (i) (1 to 6) of Appendix X (B), it appears that the distribution of Science Aptitude Test scores is slightly positively skewed in case of all the Boards. Over all, we can easily conclude that the distribution of scores at various interview boards follow the normal distributions.

The distribution of the essay marks from histograms B (ii) (1 to 6) is more or less identical at all the Boards, and follow the normal distribution.

A perusal of the histograms B (iii) (1 to 6) of the aforesaid Appendix reveals that the distributions of the scores on the project report at various interview boards are positively skewed, with very low measure of skewness. Moreover, except at Delhi Board, the distribution of scores at the remaining boards follows the normal distribution. The histogram at the Bombay Board is of a bimodal nature.

The distribution of scores on the basis of interviews is positively skewed for all the Boards, with maximum measure of skewness ($\sqrt{\beta_1} = 1.25$) at Delhi Board and the least at Dehradun Board ($\sqrt{\beta_1} = 0.278$).

6.6 A FOLLOW-UP STUDY OF 1964, 1965 and 1966 AWARDEES WHO JOINED BASIC SCIENCE COURSES :

A perusal of Appendix XI will reveal that the correlation between the S. T. S. total and the marks scored by the awardees at their B Sc. (final) examination is very low. This may be due to the different norms and standards adopted implicitly by the different universities in the country to measure the academic achievements. Besides, these marks measure primarily the actual achievement (with imperfect reliability and validity) whereas S. T. S. tests are intended to guage scientific aptitude (with greater reliability and validity) rather than pure achievment. Again the relationship between aptitude and achievement may not be exactly linear as is measured by the product moment correlation.

This low correlation may also be due to comparative low reliability of the scores in essay paper and project report. This is due to the descriptive nature of both these tools of selection.

The correlation between the scores on S. A. T. and the %age of the marks secured in B.Sc. (final), though significant, is low. This may partially by due to some of the factors explained above. The significance of the correlation may be due to the following reasons :—

(a) In some universities the questions are so set that there is more weightage to the thought type questions, testing the specific ability of the students regarding his subject of study, rather than testing the

bookish knowledge. This trend is being followed more at the higher stages like B.Sc., M. Sc. etc., but less at the Higher Secondary/I.S C/ Pre-university examinations. That is why the correlation between the scores in S.A.T. and the percentage of marks at the Higher Secondary or equivalent is not significant.

(b) The scholastic situations at selected institutes of higher learning are so structured that they may activate the powers of higher learning and creative abilities of the academically bright students. Similar is the scope of the S.A.T.

6.7 SOME CORRELATIONAL FIGURES AT A GLANCE.

In Appendix XIII there are 77 correlations between the following variables:-

(a) Selection tools of the National Science Talent Search Examination;

(b) Marks scored at class X or at equivalent standard in science subjects viz., Physics, Chemistry, Biology, Mathematics and General Science.

(c) Marks scored at class XI or at equivalent standard in science subjects (viz., Physics, Chemistry, Biology, Mathematics).

A glance at the correlational figures at Sl. No. 1 to 9 in this Appendix, representing the intercorrelations of the marks scored at the high school or equivalent standards in various science subjects, reveals that all the figures are significant except the inter-correlations beeween the marks scored in(i) Chemistry & Biology (ii) Physics & Biology (iii) Mathematics & Biology. This may be due to small sample size.

A perusal of the correlational figures at Serial No. 39 to 48 will reveal that all the inter-correlational figures are significant at 5% level, except the inter-correlation between the marks scored by the awardees in Mathematics and Biology papers at Higher Secondary level or at equivalent standard. This again may be due to the factor explained above. The above correlations give a general impression that a student scoring high in one subject is likely to do well in other subjects too, but the degree of his achievement in each subject will of-course be different.

The inter-correlational figures at Sr. No. 35 to 38 represent the correlations (degree of association) of marks scored by the selected awardees in science subjects (at high school level or its equivalent) with the marks scored at the Higher Secondary level or its equivalent. All the inter-correlations are significant at 5% level except the correlation between the marks scored in Biology at class X and XI respectively, which shows that some of the low achievers at high school level have shown a marked progress at the higher

secondary level whereas the high achievers have not been able to keep constant pace, which can be easily viewed from the raw data. These inter-correlations infact give us the predictive validity of the High School marks. It may be argued that these validity figures are higher than the figures obtained by correlating National Science Talent Search scores with the High School marks. This may be due to the common content factor in case of the former.

The figures at Sr. No. 74 to 77 give the inter-correlations of marks scored in general science, which is one of the papers at the high school level, with the marks scored in each of the science subjects viz., Physics, Chemistry, Mathematics and the total at the Higher Secondary level. All the correlational figures are significant at 1% level, except in case of Chemistry. The plausible reason for this can be that the content matter of chemistry mostly consists of rote memory work and the sample size is very low and is not a complete representative of the population.

On a perusal of correlational figues at Sr. No. 30 to 34 of the Appendix XIII, representing the inter-correlations of National Science Talent Science Talent Search tests with High School marks in the science subjects, all the figures are not significant. This may be due to the usual imperfect reliability and validity of the essay type examinations prevalent at the school stage. Secondly, Science Talent Search Tests are primarily aptitude tests while the High and Higher Secondary School examinations are pure achievement tests. Thirdly, correlation has been worked out with the total and the partial scholastic achievement.

Figures at Sr. No. 69 to 73 gives the correlations of National Science Talent Search total with scores in Physics, Chemistry, Mathematics and scores at the Higher Secondary examination. All the five correlations, except in case of Biology, are not significant at 5% level. In case of Biology though the figure is significant but low. This also may be explained on identical lines as stated above. It may be observed that the Science Talent Search scores are primarily indicators of scientific aptitude and creativity (as against achievement) and hence can be validated against standardised Scientific Aptitude Tests only or against actual contributions of awardees in the scientific and technological fields. The figures at Sr. No. 10 to 14 represent the degree of association of marks scored by the awardees (selected group) in Science Aptitude Test (one of the selection tools of the National Science Talent Search Examination) with the marks scored at class X or at equivalent standard in basic sciences (i.e. Physics, Chemistry, Mathematics and Biology). Most of the calculated correlations are not significant at 5% level. This may be due to different norms adopted implicitly by the different schools in the country to measure the academic achievements. Besides, the school marks measure primarily the actual achievement (with imperfect validity and reliability), whereas this objective test is intended to gauge scienctific aptitude (with greater validity and

reliability) rather than pure achievement. Again, the relationship between achievement and aptitude may not be exactly linear as is measured by the product moment correlation co-efficient. Moreover, in the Science Aptitude Test an attempt has been made to include maximum number of thought type questions, which are non-curricular in nature and test the powers of reasoning, comprehension and critical thinking.

A glance over the correlational figures at Sr. No. 15 to 19, representing the association between the marks scored in the essay paper and the marks scored at class X or equivalent level in the basic sciences, reveals that all the calculated correlations are not significant. The possibility of non-significance and the negative correlation as obtained here, may be due to the facts : (a) that the essay examination is highly saturated with verbal fluency, handwriting and allied factors which may not be present in usual scholastic subjects or (b) the sample may not be a complete representative of the population. According to the eligibility conditions, the span of the scores in science subjects will bear a minimum cut-off point, while in essay this range is from 0 to 100%. The empirical validity of this tool can be found out by the multiple correlation "R". The correlational figures from Sr. No 20 to 24, which represent the correlation between the marks scored in various science subjects at High School level or at equivalent standard and the Project Report, the figures calculated are negative and are not significant. Similar is the case with the Interview marks. This again may be explained on identical lines as stated above.

The figures at Sr. No. 49 to 53 represent the correlation between the marks scored in Science Aptitude Test and the marks scored in various science subjctes at the Higher Secondary level or at an equivalent standard and also with the total marks obtained at these stages. It is observed that all the calculated correlations are significant at 5% level. This not only serves as a reliable criterion measure but also indicates the predictive aspect of the Science Aptitude Test. It may, however, be pointed out that the criterion scores are not very reliable and valid because of obvious reasons.

6.8 ITEM ANALYSIS OF THE SCIENCE APTITUDE TEST :

In order to judge the suitability of the different test items, a detailed item-analysis has been carried out, which is reported in the Appendix (XIV).

The top and bottom groups constituted upper and lower 27% candidates emerging out of a stratified proportional sample of size 600. The discriminative and difficulty values have been calculated from the item-analysis chart by by A.E. Harper, B. Das Gupta & S.P. Sangal.

It will be noted that on the basis of the difficulty values and discriminating power of items (taking a cut-off point at 18 for discriminative power and diffi-

culty level between 25 to 67), 32% of the items of factual type, 24.5% of thought type and 27.6% of the total items in both parts of the test have been rejected, mostly in areas of Mathematics and Astronomy. In case of non-curricular (excluding Astronomy) subjects, the rejection is only 21% of the total rejected thought type items whereas the over-all rejection of items in compulsory part of the test is 19%, which is much less in comparison to that of last year's percentage of rejection (40% and 20%), thereby giving a general impression that the examinees have better acquaintance with these new areas (especially Geology, Physiology & Hygiene, Astronomy, History & Philosophy of Science, Bio-chemistry, Engineering and Agriculture, where most of the items are discriminative). It will be noted that items on Mathematics and Chemistry in both the parts of the test are mostly non-discriminative. One plausible reason for this can be that the content matter of Mathematics mostly consists of new areas like inverse operators etc. which are totally new ideas for the examinees and moreover it has been observed from the previous years that the %age of the students who opt for Mathematics as their optional part is very low in comparison to other optional parts of the test. The second reason is that the high achievers, who have opted for the optional part as Mathematics, have attempted the thought type and factual type questions with more concentration and in their case the distractors were not equally attractive whereas in the case of the low achievers, who opted Mathematics as their optional part and attempted the question successfully, the success seems to be mostly due to the guess work because all the distractors were found to be plausible in their case. The third reason is that some of the items are incorrectly responded by most of the high achievers in comparison to that of the low achievers and some of the items are equally responded by both the groups, thereby no significant difference exists between the number of correct items in the top group and the bottom group.

One of the plausible reasons for the non-discriminative items in Chemistry in both parts of the test, can be that the content matter of Chemistry mostly consists of rote memory work and hence it is really difficult for high and under achievers to be distinguished on higher mental powers and creative abilities.

A few items with difficulty index beyond 65 have also been taken because of the content validity.

Applying the rigid criteria of selecting items, 199 items have been found to be suitable for future use. Since the tool has been found to be highly reliable (r_{tt}=0.92), it can be hoped that the pool of items can safely be used by the Secondary Examination Boards of various states and territories. Moreover, in such a perfect tool of measuring scientific aptitude, this high reliability co-efficient (which is a very good measure of internal consistency of the items) is normally expected. It is an interesting feature that the students in the top

group (27%) have answered questions on new areas much better than the questions on traditional curricular branches. This is encouraging because it indicates wide reading on the part of brilliant students. In case of bottom group (27%) the position is not so satisfactory. These students tend to answer questions correctly on traditional curricular themes in a better way than items on new information. Again, it is encouraging to find on a perusal of table (B) of the Appendix (XIV) that students both in the top and the bottom groups have answered the questions of thought type in a much better way than questions of factual type, or in other words, thought type items have proved to be more discriminative than the factual type items, because the %age rejection of items of factual type is more.

It indicates that the students do possess adequate mental capacities to attune to the new type of items, where higher mental powers are called forth as against rote memory. It also indicates that the thought type questions elecit spontaneous motivation, which is vital for proper academic distinction. This is clearly brought out by consistent high achievement on these types of items. It further indicates that the powers of critical thinking, analysis-synthesis and reasoning occupy an important place in the effective teaching and learning of science at the Secondary stage. Items which are suitable on the basis of discriminating and difficulty values are given below :—

Compulsory part of the Test :

1 to 12, 14 to 21, 24, 26, 29 to 34, 36 to 50, 52 to 59, 61, 63 to 67, 71 to 73 and 75.

Optional part of the Test (N_1=61)

(i) Physics :— 1 to 11, 13, 15, 18, 19, 23, 25, 27 to 37, 39, 43 to 50 (N_2=37)

(ii) Chemistry :— 3, 5,7 to 23, 25, 27 to 33, 35 to 39, 41 to 46, 49 and 50 (N_3=40)

(iii) Biology :— 3, 6, 8 9, 12, 15 to 18, 20, 21, 23, to 29, 31 to 33, 35, 41, 44 to 50 (N_4=30)

(iv) Mathematics :— 1, 2, 5 to 8, 12, 14 to 16, 21, 22, 24 to 35, 38 to 42, 49, and 50 (N_5=31)

An analysis of the item chart indicates that the test is a mixture of very difficult, moderately difficult and a few easy items. Generally, in such a type of test, items with high discriminating power and with a difficulty index near 50 is preferred. In a highly homogeneous test a wide range of difficulty value is desirable and that is why in the present case the cut-off point for difficulty index is 25 to 67.

One caution, however, needs continuous emphasis, i.e. item analysis data can never be the final criterion for inclusion or exclusion of test items. It is only an aid to selection. It can also give valuable hints for editing an item, so as to eliminate useless distractors, in-correct ambiguities, or make the item easier or harder as desired. It may also be noted that a low discrimination value does not necessarily disqualify an item, unless the test is presumed to be completely homogeneous.

6.9 RELIABILITY OF THE SCIENCE APTITUDE TEST :

The Reliability of the Science Aptitude Test has been worked out by Kuder-Richardson formula (KR-20) as stated in the Appendix XV which gives the internal consistency of the test items and thus the dependability of the test scores. For the compulsory part of the test, the figure comes out to be 0.92 and for the optional parts of the test, the figures are given below :—

(i)	Physics	$r_{11}=0.86$
(ii)	Chemistry	$r_{11}=0.88$
(iii)	Biology	$r_{11}=0.89$
(iv)	Mathematics	$r_{11}=0.72$

This method of rational equivalence stresses the inter-correlations of the items in the test and the correlation of the items with test as a whole.

In order to visualise toe effect on the reliability of the different parts of Science Aptitude Test, year 1967, a small project was carried out and a detaied description of the study is given in Appendix XX.

6.10 INTER-CORRELATIONS OF THE SUB-TESTS OF THE SCIENCE APTITUDE TEST AND OTHER TESTS

From the table of inter-correlations of the various sub-tests, (Appendix XVI) it is interesting to note that there is a marked difference amongst the correlational figures of the various sub-tests calculated on the basis of (i) a random sample of selected awardees and (ii) a stratified proportional random sample of size 435 (roughly 7% of the candidates who took the National Science Talent Search Examination in the year 1967).

In case of sample (i) most of the inter-correlations worked out to be negative, particularly the correlation between the marks scored in S.A.T. and Interview is negative and this figure is significant at 0.05 level. This gives a general impression that the high achievers have not shown good performance in the Interview in comparison to the low achievers. Experience has shown that this often happens at the various regional interview-boards. This is because of the following reasons :

(a) Interview marks are not allotted on the basis of the theory marks (aggregate of the scores on S.A.T., Essay & Project).

(2) The criteria at the interview boards are entirely different than those in vogue at the theory tests and secondly the abilities involved are quite different in the two situations. The only common factor is "scientific aptitude" and its due assessment. In the Interview, special weightage is given to the following criteria of judgment :

(a) Scientific attitude
(b) problem solving ability
(c) creative thinking
(d) scientific interest
(e) self confidence
(f) verbal fluency and comprehension
(g) information on current scientific topics

(3) The sample is not a complete respresentative of the entire population or in other words the random sample is from a truncated population i.e. it is a specific group.

This shows that if a sample is not properly chosen, it will reveal an entirely different picture of inter-correlational figures.

In case of sample (ii), all the inter-correlations are significant at 5% level and some at 1% level, except the inter-correlations of the scores in Interview with the scores on (a) essay paper (b) project Report. This may be due to the aforesaid reason explained at number (2). Since the inter-correlations of the various sub-tests are low it indicates that four different tools are measuring different abilities and there is no overlap in their domains. These four selection tools can be used as a battery.

A brief description of sample (ii)

The population representing the marks secured by the candidates in the National Science Talent Search Examination were classified into the various class intervals of size 10 each. This represented the strata and from each strata, a random sample of roughly 7% of the size of each strata was drawn with the help of Tippet Random numbers. The assumption "irrespective of states" has to be laid down because our selection tools are based on the assumption that uniform educational standards prevail amongst the students, coming from the various educated grades available in the states.

Though the essay examination is highly saturated with verbal fluency, expression, handwriting and allied factors, (which may sometimes inhibit the process of deep thinking and concentration, which are vital for answering the type of questions put in the Science Aptitude Test), yet the obtained scores

give significant inter-correlations with the two other tools of selection. This represents a vital change from the results obtained in the previous years, which may be due to better sampling techniques. We expect it to be so because in all the selection tools we are judging a common factor "scientific aptitude" of the students. This does not mean that the tools are overlapping each other's domain. However, with the help of factorial studies we can establish the relationship between the abilities called into play in responding to these four selection tools.

The insignificance of the inter-correlation between project report and Interview may be due to the fact that the teacher's contribution towards writing the Project Report may be so great that an examinee has very little grasp over the content matter of the Report with the result that he has to cut a sorry figure at the interview, when he is asked questions based on his written Report. Experience has shown that this often happens at the various regional interview boards.

This does not mean that this tool of selection may be abondoned because a good project report does indicate the originality of the ideas of an examinee together with his creative experimental attitude. Hence it forms a vital tool of selection for singling out potential students distinguished from mediocres.

On the other hand, the interviews do carry with them the hazards of subjectivity alongside being a vital tool for judging the depth in a particular branch of knowledge. The correlations of the S. T. S. total with the sub-tests are all positive and highly significant. This is on account of the overlap between the National Science Talent Search total (which is an aggregate of the sub-tests) and the sub-tests.

6.11 A detailed study of the population has been made in Appendix XVII and XVIII, which give the statewise frequency distribution of the marks scored by the candidates in the Essay Paper, Project Report and the Science Aptitude Test. Measures of central tendencies have also been reported on a statewise basis. In order to have an overall picture of the frequency distributions of scores on S.A.T. prevailing in the various states over the four years (1964, 65, 66 and 67), graphs of relative frequencies are included in the Appendix XVIII.

The data incorported in both the Appendices is very useful for making yearwise comparative study among the various states.

6.12 Topics for some research studies have been included in Appendix XII. It is contemplated to incorporate the findings of some of these studies in the subsequent annual reports.

6.13 Appendix (XIX) gives details of the follow-up study of some of the awardees and also gives comparative data with a parallel control group.

A random sample of sixty first divisioners was drawn from the finally selected awardees and was designated as the selected group. A similar random sample of candidates, who were not able to secure a position in the merit list of the National Science Talent Search examination because of their comparatively poor performance at all the selection tools has been listed as unselected group. The means of the achievement scores of the two groups in the eight different areas were compared and it was found that there was significant difference in favour of selected candidates in all the areas except in the case of Biology and Mathematics. The natural conclusion is that the Science Aptitude Test, alongwith allied techniques, seem to be more valid and reliable tools for the selection of talented students in basic sciences as compared to the Higher Secondary and Indian School Examination results. In order to find the prognostic value of the tests, follow-up programme for these two groups is proposed to be undertaken.

The non-significance of the difference between the average scores in Mathematics and Biology of the aforesaid two groups may be due to the small sample or the sample selected may not be a complete representative of the entire group. Evidently, no weightage can be given to the results obtained herein because the sample is too small and is chosen at random without any appropriate sampling techniques. Study performed in preceding years reveals that there has been a significant difference between the average scores of the two groups in Mathematics and Biology. This is supported by a follow-up study performed for the selected and unselected groups with regard to their positions at the 1st year of the B.Sc. (Pass/Hons.) course and at the final year of the B.Sc. (Pass/Hons.) course. Though there is significant difference of the average scores of the two groups in case of Mathematics and in case of aggregate score, but in the major three subjects of the basic sciences there is no significant difference of the average scores. One can easily drawn an impression that the National Science Talent Search awardees are in no way better than the other students with regard to their academic/scholastic achievements in Physics, Chemistry and Biology, which is not a very fair conclusion because of the fact that no generalised conclusions can be drawn based on such a small sample size of the groups, selected at random. Moreover, unreliable and invalid achievement tests (laying more stress on the preassigned curricular coverage) cannot give the true picture of the candidate's intellectual abilities and aptitude. It has been verified from the Reports of various Directors of the Summer Schools, organised every year at various places in the country, that most of our awardees possess good aptitude for science and have conducted many research studies designed by themselves under the overall guidance of the resource persons.

6.14 Appendix XX gives the results of some of the research studies conducted at the Department. Some of the findings are very useful in improving the quality of the Scheme.

APPENDIX I (A)

A Report of the Summer Schools organized in May-June, 1967 for the awardees of the National Science Talent Search Scheme

One of the chief objectives of the National Science Talent Search Scheme is the planning of accelerated programmes of education for the awardees so that they may utilise their mental potentialities to the maximum extent.

In 1964, one week workshops were organised for the scholars of the pilot project of 1963 and the awardees of 1964. At these workshops, some lectures were held on the current developments in the field of basic sciences. Alongside, practical training was imparted in the workshop at the University of Delhi.

In 1965, five summer schools were held in different parts of the country and the duration was one month. At these summer schools, the awardees were put under the charge of eminent teachers of science drawn from various institutions of higher learning. Lectures, laboratory work and workshop practice were the important features. In 1966, 16 summer schools were held on almost the same lines as those of 1965. The additional feature was the introduction of Audio-Visual techniques for Science Education. The students were also encouraged to undertake intensive library work

In 1967, 15 summer schools were held in different parts of the country. The participants were given the opportunity of designing some research projects in their areas of specific aptitudes. This was in addition to lectures, film-shows, laboratory work and excursions. This experience of exposing the students to project-oriented work proved to be very useful, both to the students as well as to the resource persons. The participants were further encouraged to complete their work during the one month's duration of the summer school.

The consolidated objectives of running the summer schools are given below :—

(1) To establish inter-personal contact between the teachers and the taught;

(2) to enable the talented students to develop their intellectual potentialities in the best possible way;

(3) to motivate the experimental curiosity of the students so as to stimulate the creativity and research spirit;

(4) to enable the promising students to exchange views with their class-fellows and thus to promote a greater understanding and appreciation of each other's views;

(5) to enable the talented students to develop new basic concepts in their fields of specialization;

(6) to encourage the scholars to pin-point their academic interests and aptitudes; and

(7) to produce an accelerated programme of science education.

The boarding and lodging arrangements were made for the participants by the Director of the summer school concerned and all the expenses on this account were met by the N.C.E.R.T.

At the end of the summer school detailed evaluation proformas were filled in, both by the participants and the resource persons.

The details regarding some of the summer schools are given below.

A sample project report is also included in this appendix which clearly demonstrates the quality of work done at these summer schools.

Summer School in Physics

Venue : Saha Institute of Nuclear Physics, Calcutta-9.

Director : Prof. B. D. Nagchaudhuri,
Director,
Saha Institute of Nuclear Physics,
Calcutta-9.

Duration : 15th May to 10th June, 1967

Twenty-seven students attended the summer school. These students had completed final year of the three-years B. Sc. course or its equivalent.

Lectures and problem-sessions were held on the following topics:

(i) Plasma Physics (Introduction and applications in cosmology).
(ii) Plasma Physics (production of plusma, its various applications and diagnostics).
(iii) Structure of Nuclear physics.
(iv) Quantum Machanics and Elementary Particle Physics (An introduction).
(v) Relativity, its application to cosmology.
(vi) Satellite communication and some aspects of space physics.
(vii) Masers and Lasers etc.
(viii) Physical basis of life.

Some of the major experiments conducted by the students are given below:

(a) Photon diffraction
(b) Beta—absorption
(c) Mass—spectrograph
(d) e/m measurement
(e) Emulsion technique
(f) Lissajous figures
(g) Receiver—Transmitter set
(h) Dielectric constant using microwaves
(i) An ionospheric model
(j) Determination of Plasma parameters by a Langmuir probe
(k) Compton scattering
(l) Computation by calculating machines.

Students visited the following laboratories of the Saha Institute: (a) Cyclotron (b) Cockroft walton Generator (c) Electron—microscope (d) Mass spectrometer (e) Mass separator (f) Beta—ray spectroscopy (g) NMR spectroscopy (h) ESR and NQR—spectroscopy.

SUMMER SCHOOL IN PHYSICS

Venue : Physics Department,
Panjab University,
Chandigarh.

Director : Prof. B.M. Anand,
Head of the Physics Deptt.
Panjab University, Chandigarh.

Duration : 1st June to 30th June, 1967.

Fortytwo students (including nineteen girls) attended the Summer School. These students had completed Ist year of the three-year B.Sc course or its equivalent.

Some special features of the summer school

Free and frank discussions between the staff and students were encouraged. The lectures were so arranged as to have good participation from students during the class. Some lectures were devoted towards the good understanding of the fundamental concepts in Physics and others were of an informative type on modern topics.

Prof. Noah Sherman of Michigan University, U.S A. and Prof. Arthur Rouse of St. Louis University, U.S.A., who were at the Department, participated in the Summer School activities from June 1 to June 9, 1967.

Special lectures were given by Dr. Sampuran Singh, Director, Terminal Ballistic Research Laboratory, Chandigarh on 'Ultra high speed photography'

and Dr. J. N. Nanda, Director, Defence Research Laboratory (Materials), Kanpur on 'Operational Research'.

A 'Travelling Science show' was presented to the students on June 10, by Regional College of Education, Ajmer.

An educational trip was arranged to Fertiliser Factory, Nangal and Bhakra Dam.

Project Work :

Each participant worked on a project of his/her choice and submitted a report. A short talk was given by each participant during the last week of the summer School.

Evaluation :—Detailed evaluation of the various activities of the summer school was undertaken, both by the participants and the resource persons.

Summer School in Physics

Venue : Physics Department,
Indian Institute of Technology,
New Delhi.

Director : Prof. S. C. Jain,
Head of the Physics Deptt.
I.I.T., Haus Khas,
New Delhi.

Duration : 15th May to 13th June, 1967.

Twenty-three students (including nine girls) attended the Summer School. These students had completed second year of the three years B.Sc. course or its equivalent.

Lectures, discussions and demonstrations were based on the following topics :

(a) Principles of Optics & Optical Instruments

Theories of light and their applications to the different aspects of instrumentation.

Ray theory of light. Definition of a perfect image. Primary aberrations. Nature of images in optical systems suffering from aberrations. Control of aberrations in eye-pieces, microscopes, telescopes. Photographic cameras and projectors.

Inversion and reversion of images. Theory of prisms & prism combinations used in periscopes, photometers, binoculars, sighting telescopes etc.

Wave nature of light. Interference of light. Different types of interference fringes used in testing precision optical components.

Diffraction of light and its application in testing the performance of optical systems.

Optical glass suitable for the production of precision optical components. Necessity of different types of optical glass. Polarised light and its use in testing optical glass.

Optical workshop. Physical principles involved in the production of precision surfaces on glass. Knife edge test for mirrors.

(b) General and Modern Physics:

Fundamental Particles
Accelerators
e & M
Mossbauer Effect & Applications

(c) Principles of Nuclear Physics & Instruments

Radio-activity & its measurements
Nuclear Models
Reactors
Cosmic Radiation

(d) Kinetic Theory of Gases

Elementary Ideas
Assumptions about perfect gas
Deviation of Gas Laws.
Interpretation of temperature
Mean Free Path
Transport Phenomena (Diffusion, Viscosity, thermal conductivity)
Velocity distribution of molecules
Calculation of Averages of Simple functions of Velocities ; Gamma Functions
Equipartition of Energy
Specific Heat of Gases
Specific Heat of Solids
Effusion and its application to leak in high pressure and vacuum system.
Free electron theory of solids and Thermionic Emission
Brownian Motion
Van-der-Waal's Equation of State and its application to Liquifaction of Gases
Dray on Satellites.
Problems.

Elementary Statistics :

Introduction
Systematic and Random Errors
Mean and Weighted Mean
Mean Deviation and Standard Deviation
Chi-square Test
Co-efficient of Correlation
Method of Least Square
Continuous Distribution
Probability
Some Interesting Applications

Electrical Conduction in Gases and Solids

Ionization in Gases
Thermal, Electrical, Photoelectric
Langevin's Theory of Electrical Conduction
D.C. Field
A.C. Field
Transient Fields
Electron Collisions in Gases
Effect of Magnetic Field
Power Loss in a Gas
Propagation of Radio Waves in Ionized Gases.
Applications to Ionosphere
Band Structure of Solids—metals, insulators, semiconductors, p-semi-conductors, intrinsic-semiconductors.
Free electron theory of solids
Transport phenomena in solids

Atmospheric Optics & Lasers

1. Introduction to Mirage and Looming
2. Formation of Images in Homogeneous Media, Caustic Curve
3. Quantitative Theory of Mirage and Looming
4. Applications of this theory to determination of Lapse Rate
5. Coherence
6. Spontaneous and Simulated Emission
7. Population Inversion
8. Ruby Laser
9. Gas Laser
10. Solid State Lasers.

The following experiments were performed by the students :

1. Use of Fizeau fringes for studying the nature of optical flats and curved surfaces & to determine their accuracy.
2. Use of a Fizeau interferometer for the determination of parallelism of beam dividers.
3. Use of Angle dekkors for the determination of angles of prisms accurately
4. Setting up a high power microscope to make the best use of the optical system available.
5. Determination of the Field of view, Resolving power etc. of telescopes.
6. To set up a projector and study the nature of the images on the screen·
7. e/m by discharge tube
8. Discharge of gases
9. Lissajous figures on Oscilloscope
10. Transistorised amplifier.
11. Velocity of Ultrasonic waves
12. Geiger counter and statistics
13. Gama spectrum by scintillator
14. 'e' by Millikans apparatus.
15. Uses of radio-isotopes
16. Emulsion as detector
17. Zone Refining of Naphthalene
18. Four Probe Method for Measurement of Conductivity of Semiconductors.
19. Measurement of Hall Effect and Magneto-resistance of Semiconductors.
20. Characteristics of Transistor.
21. Characteristics of a Solar Cell, measurement of recombination coefficient carriers.
22. Measurement of e/m by measuring diode characteristics at different temperatures.

A series of useful talks were delivered by some of the participants :

Topic	*Participants*
1. Visual Estimation of Length	1. Tritib K. Gupta 2. Sumantra Goshal
2. Fabrication of a solar cell	1. Miss Sreejeta Ganguli 2. Miss Manju Baljee 3. Miss Radha Rao 4. Nirabendu Roy
3. Fabrication of an optical flat	1. Bimal Prasad 2. Ashok Kumar Dhingra 3. Raj Kishore Prasad

4. Preparation of thin films	1. Miss Gayatri Choudhary 2. Miss Meena Ghoshal 3. Miss Parvinder Kaur 4. Miss S. Subhana
5. Spark Counter	1. Sudhir Kumar
6. Growth of Crystals	1. Amrenora Singh 2. Trilok Nath Kundra 3. Bimal Sharma

Summer School in Physics

Venue : National College,
Bangalore

Director : Dr. H. Narasimhaiah
Principal and Professor of Physics
National College,
Bangalore

Duration : 8th May to 6th June, 1967.

Fifty students (including nine girls) attended the Summer School. These students had completed 1st Year of the three-years B.Sc. Course or its equivalent.

Expert level lectures were delivered on the following topics :

Fundamental Particles
Unity of Nature ; Waves & Particles ; History of Science.
Unity in Physics and Radio Astronomy.
Radioactivity and Nuclear Structure
Crystals and Solid State Physics.
Introduction to Vector Analysis ; Elements of Probability.

Laboratory Works :

The following experiments were arranged for the participants :

1. Determination of Cauchy's constants for the material of a prism.
2. Determination of wave length of monochromatic radiation using Biprism on Optical bench.
3. Diffraction grating.
4. Interference of sound.
5. Current sensitiveness of a suspended coil galvanometer.
6. Triode characteristics.

The following experiments were arranged in the Indian Institute of Science.

1. Crystal growing
2. Determination of interfacial angles of crystals
3. Energies of β-rays
4. β-ray spectrum
5. Half life of β-rays of a Thorium isotope.

Project Work :

The projects, undertaken by the participants, are given below :

1. Estimation of "g" by various methods
2. Crystal Receiver
3. Low voltage power Rectifier
4. Analogues of Electronic Circuits
5. Harmonograph
6. Transistor Multivibrator
7. Lissajous figures.
8. Crystal Growth and Moire Pattern
9. Simple range finder
10. D.C. Motor
11. Current amplifier
12. Absorption Spectra
13. Ripple Tank
14. Determination of "e" using a Transistor
15. A device to measure current.
16. Transistorised Burglar Alarm
17. Transistor Receiver
18. Water heater with temperature control

Lectures on the following topics, were delivered by the students :

1. Zeeman Effect
2. Radio Receiver
3. Lissajous figures
4. Neutron
5. Nuclear fission
6. Cosmic rays
7. Pulsating stars
8. Broadcasting
9. Nature of the Universe
10. Doppler Effect
11. Theories of Light
12. Mesons
13. Compton Effect
14. $E = mc^2$

15. Theories of magnetism
16. Ultrasonics
17. Kinetic Theory of gases
18. Black body radiation
19. Lasers
20. Electron
21. Millikan's expt
22. Bohr's theory of Hydrogen like atom
23. Super Conductivity
24. Fine & Hyperfine structure of line Spectra
25. Wilson cloud chamber
26. Cathode-ray oscillograph
27. Electromagnetic Spectrum
28. Matter Waves
29. Photoelectric effect
30. Particle accelerators
31. Beta Decay
32. Special theory of relativity
33. Cosmic rays
34. Radar
35. Radio-isotopes
36. Semi-conductors
37. Artificial Radio-activity
38. Thermionic Emission
39. Special theory of relativity

Visits :

Visits to Sir M.V. Memorial Museum and National Aeronautic Laboratory were arranged. Film shows were arranged on scientific themes.

Detailed visits to L.R.D.E., Hindustan Machine Tools factory and H.M.T. Watch Factory were arranged for the benefit of the participants.

The participants also visited Raman Institute. Dr. C.V. Raman delivered a lecture on "Colour Vision".

Summer School in Physics

Venue : Ram Narain Ruia College,
Bombay.

Director : Dr. R.D.Godbole,
Principal,
R.N. Ruia College,
Bombay.

Duration : 15th May to 13th June, 1967

Twenty-one students (including three girls) attended the Summer School. These students had completed the second year of the three years B.Sc. Course or its equivalent.

The lectures were delivered on the following topics :

1. Conservation laws and symmetries in particle physics.
2. Classical and Quantum Mechanics.
3. Introduction to Nuclear reactions.
4. Evolution of Quantum theory
5. Quantum Mechanics
6. Nuclear Spectroscopy
7. Positronium in solids.

The following experiments were arranged :

1. e by Millikan's method
2. Velocity of light
3. Gravitational constant
4. Zeeman Effect
5. Gamma Ray Spectrometer
6. Tuned Grid Oscillator
7. Saw tooth generator using thyratron.
8. Electronic Timer using multi-vibrator.
9. Uses of junction diode.

The following projects were undertaken by some of the students :

(i) R-C Coupled amplifier
(ii) A six transistor receiving set
(iii) Variation of intensity of a source of light when kept in a magnetic field.

A visit to Bhabha Atomic Energy Establishment was arranged.

Summer School in Chemistry

Venue : Chemistry Department,
University of Delhi,
Delhi-7.

Director : Professor R.P. Mitra
Head of the Chemistry Deptt.
Delhi University, Delhi-7.

Duration : 8th May to 6th June, 1967

Eleven students in all attended the Summer School. These students had completed the final year of the three.years B.Sc. course or its equivalent. The academic work of the School was done under the following heads : (i) Lectures (ii) Project work and (iii) Group discussions.

(i) Lectures

One lecture (of one and half hour's duration) was arranged everyday on selected topics giving a perspective of the principles of chemistry. The lectures were followed by questions and answers.

(ii) Project Work

The experimental part of the School programme consisted of project work only. Students were required to choose from a exhaustive list, a project that they would like to undertake. They were provided with suitable library references to enable them to deal with the project work intelligently and the resource persons helped them to overcome their difficulties. They were encouraged to take initiative in making suitable alterations in experimental conditions etc., wherever necessary.

(iii) Group Discussions :

Group discussions were conducted on selected topics by the resource persons. The topics for the discussion had a direct relation with the subject matter of lectures delivered by the resource persons.

List of some of the projects :

1. The use of slide rule, desk calculator and computer (IBM 1620) for solving problems of chemical interest. The emphasis was be on the problem or the technique, depending upon the student.

2. Deducing the structure of a chemical compound by analysis of its Nuclear Magnetic resonance spectra.

3. Studies on cobalt (III) complexes.

4. Studies on chromium (III) complexes.

5. Pyrolysis of some metal carboxylates : Reaction products will be studied by thin layer and co-chromatographic techniques.

6. Preparation and T.L.C. and I.R. studies of copper complexes of diketonic compounds.

7. Oxidation of substituted toluenes with different oxidising agents in order to find the best method for the preparation of benzoic acids.

8. Studies on different types of adsorbents to test their suitability for thin layer chromatography.

9. Differential thermal analysis studies of some metal oxinates involving the setting up of a DTA apparatus, preparing the oxinates and determining transition temperatures and heats of reaction of phase transformation of the oxinates.

10. Studies of some physical properties (e.g. dissociation constants, association, polymorphism) of fatty acids, employing X-ray diffraction, ebullioscopic and potentio-metric techniques.

Summer School in Chemistry

Venue : St. Joseph College,
Bangalore.

Director : Dr. K. Srinivasan, Principal and Professor of Chemistry
College of Arts & Science,
Bangalore

Duration : 8th May to 6th June, 1967

Thirty-two students attended the Summer School. These students had completed 1st year of the three-years B. Sc. Course or its equivalent.

The following topics were dealt with in the lecture programme:

A Inorganic Chemistry	—	Ligand Field Theory
B Organic Chemistry	—	Modern Organic Chemistry with emphasis on mechanism and stereochemistry.
C Physical Chemistry	—	Thermodynamic, statistical mechanics, Theory of metals, Electrode phenomena, surface Chemistry.

Project Work :

The students were attending the summer school for the first time. They did not come to school with projects of their own. This situation had been anticipated by the resource persons and a list of projects had been drawn up, keeping in mind the level of students and the resources available.

The list of projects undertaken is given below :—

1. To grow sodium nitrate crystals; to study its crystal structure and to construct a simple polarimeter.

2. To set up a manual polarograph and use it to understand the basic principles of direct current polarography.

3. To construct a sensitive calorimeter and to determine the heat of neturalisation of an acid and the heat of solution of ions and to study whether the decomposition of ammonium nitrate interferes with its employment in the production of ammonia.

4. To study the corrosion of Zinc in an acid medium and construct Evan's diagram.

5. To study the difference in the surface active properties of a fatty acid in the unionised and ionised states.

6. To extract curcunin from Turmeric by soxhlet extraction and to investigate the feasibility of converting it into vanillin.

7. To isolate sesamin from gingeli oil and to study its isomerisation.

8. To construct a demonstration gas-chromatograph and to analyse a simple mixture.

Scientific visits and Excursions :—

The participants were taken on excursions to the Indian Institute of Science, the Hindustan Machine Tools Ltd., the Indian Telephone Industries Ltd., and the Bharat Electronics Ltd.

Evaluation of students :—

The students were evaluated on the basis of the constant personal contacts by the resource persons and also on the basis of an oral examination of each of them at the end of the school. This oral examination, by all the resource persons sitting together with the students, was carried out in a very informal manner and the student was put at ease in the beginning. The object was to provide the best opportunity to the student to reveal what he had learnt during the period of the school. This was considered bettor than a written examination.

Summer School in Chemistry

Venue : Chemistry Department,
Poona University,
Poona.

Director : Dr. V. K. Phansalkar,
Chemistry Department,
Poona University,
Poona.

Duration ; 2nd May to 31st May, 1967

Eighteen students (including ten girls) attended the Summer School. The students had completed second year of the three-years B. Sc. course or its equivalent.

Apart from usual lectures given by the resource persons on 'Principles of Chemistry' two guest lectures were arranged on 'Stability of Nucleus' and 'Application of Science to every-day life.'

The following experiments were performed by the students
Acid—Base titration by conductometry
Dissociation Constant of Weak acid by conductometry
pH of a solution by conductometry
pH of a solution by potentiometry
Dissociation constant of an acid by potentiometry
Potentiometric estimation of halides
Acid—Base titration by potentiometry
Verification of Beer's law
Molecular wt. determination by the equilibrium method
Investigation of rate of inversion by polarimetry
Determination of degree of Association cryoscopically
Microqualitative Analysis of Inorganic cations
Use of indicators in pH determination
Study of chemical Equilibrium
Preparation of Inorganic Complex salts
Preparation of an organic compound

Besides these, quite a few projects such as determination of solubility of sparingly soluble salt by various methods, uses of chromatograph for analysis, migration of ions under the electrical field were undertaken by the students.

Summer school in Biology

Venue : University Botany Laboratory,
Madras University,
Madras.

Director : Prof. T. V. Desikachary,
University Botany Laboratory,
Madras University,
Madras

Duration : 15th May to 13th June, 1967.

Thirteen students (including eleven girls) joined the school. These participants had completed two years of B.Sc. course in different universities.

It was felt this year that the summer school may largely be oriented as a project school, thereby giving sufficient scope for original expressions by these participants, and also for creating a zest for scientific research as a worthwhile career. In pursuance of this, routine lectures were limited to a dozen and they largely centred round fundamentals and techniques involved in projects selected by the individual participants. This project-oriented work substituted routine laboratory practicals.

Lectures were delivered on the following topics :

1. Path of carbon in photosynthesis.
2. Light and electron transport in photosynthetic reduction.
3. Physiology of seed germination.
4. Chromatography.
5. Protein synthesis.
6. Factors controlling respiration.
7. Pathways in respiration and the use of respiratory inhibitors.
8. Marine environment.
9. Hormonal control of reproduction.

List of Films shown :

1. Laws of Heredity
2. Genes in action
3. DNA molecule in heredity
4. Mitosis
5. Seed Germination
6. Meiosis
7. The Sea
8. Natural Selection
9. Angiosperms
10. Gymnosperms
11. Fungi
12. Plant Ecology
13. Chick embryo
14. Growth of Plants
15. Bacteria
16. Protozoa
17. The Desert
18. The Grasslands
19. Tropical Rain Forest
20. From sand dune to forest
21. Fundamentals of nervous system
22. Temperate deciduous forest
23. Amphibian embryo
24. The high artic biome
25. Plankton on the open sea
26. Social insects
27. Blood
28. Fish embryo
29. Photosynthesis
30. Principles of Chromatograph

The following projects were taken up by the participants :

1. Microbiology of soil and air.

2. Life in the sea.

3. Some respiratory characteristics of the Blue green algae, *Anacystis nidulans*—comparison of two strains of *Anacystis nidulans* I and II.

4. Physiology of spore germination (Penicillium chrysogenum).

5. Mineral nutrition in plants.

6. Physiology of seed germination. Effect of light on germination.

7. Comparative studies on breeding, embryology and development on a few animals.

8. Study of rates of respiration in leaf tissue of cotton (Variety K6) *Gossypium arboreum*)

9. Effect of aging on oxygen-uptake of potato (*Solanum tuberosum*) tuber tissue.

10. Growth and synthesis in isolated leaf-tissue. The effect of potassium nitrate and soda water, individually and in combination, on the photosynthetic abilities of green and red tissue of *Acalypha indica ;*

11. Growth and Sporulation patterns in *Collectotrichum capsici.*

Summer School in Biology

Venue : Botany Department,
Banaras Hindu University,
Varanasi.

Director : Dr. R. Misra,
Head of the Botany Deptt.
B. H. U., Varanasi.

Duration : 15th May to 13th June, 1967.

Twelve students (includiug six girls) attended the Summer School. These students had completed 1st year of the three-year B. Sc. course or its equivalent

The lectures were delivered on the following topics :

1. What is Science ?
2. Cell structure and function
3. Structure or chromosomes
4. Structure of the gene
5. Role of genes in heredity and evolution

6. Development and growth
7. Diversity among animals
8. Reproduction in animals
9. Parasitism and hostparasite relationship.
10. Immunity and resistance
11. Useful and destructive insects.
12. Microbes : contribution to Biology
13. Nutritional patterns in plants
14. Genetic control of metabolism
15. Growth hormones
16. Flowering in plants
17. Ecosystems
18. Radiation Biology
19. Atmospheric pollution in relation to plants
20. Lichen Biology
21. Water relations of plants

The following practicals were performed by the students :

1. Study of different types of cells
2. Study of different types of chromosomes
3. Study of mitosis from smears of onion root tips
4. Study of meosis from squash preparation of grasshopper testis.
5. Study of mutants in *Drosophila melanogaster*
6. Study of fauna of ponds of B. H. U. Campus
7. Study of reproduction in *Paramecium*
8. To collect parasites from different hosts
9. Permanent preparation of the collected parasite and their identification
10. Collection and identification of useful and destructive insects
11. General survey of microbes
12. Demonstration of different fungal and bacterial cultures
13. Effect of ultraviolet light and antibiotics on micro-organisms
14. Study of oxygen uptake by plant tissues and separation of chlorophyll pigments
15. Demonstration of photoreduction by isolated chloroplasts and Hormonal studies.
16. Pond ecosystem
17. Use of radio-active isotopes in biology
18. Alternation of generations in plants
19. Lichens and Lichen substances
20. Enzymes in living tissues

Each participant was made to work on a small research project. The following projects were conducted by the students :

1. Human Blood groups
2. Somatic chromosomes of the rat
3. Meiosis in *Rattus norvegicus*
4. Sex linked inheritance
5. Study of reproduction in protozoa
6. Study of pond-fauna of the campus
7. Study of Biology and Bionomic of ectoparasites
8. Survey of the trematode parasites from the fishes of the Ganges
9. Plant foods : qualitative determination of plant foods using higher and lower plants.
10. Regulation of growth in plants
11. To study cultural behaviour of some soil micro-organisms
12. To study fsarium wilt of tomato
13. Most range to TMV in weeds
14. To study R.Q. of various plant materials
15. Seed Germination with respect to soil, light and temperature factors
16. Nutrition of plants with respect of N, P, and K.
17. Determination of lichen substances by crystallographic technique
18. Determination of pH of bark, leaf, and fruit (young and ripe) of some common trees.
19. Study of stomata and cuticle in the leaves of plants growing in sunny and shady areas.

Summer Scool in Mathematics

Venue : Mathematics Department,
I. I. T., Kanpur

Director : Dr. J. N. Kapur,
Head of the Maths. Deptt.,
I. I. T., Kanpur

Duration : 15th May to 13th June, 1967

Twenty-three students (including 3 girls) from all over the country attended the Summer School. These students had completed the first year of the three-years B. Sc. programme or equivalent there of and intended to pursue careers in mathematics or physics.

Academic Programme

This consisted of the following :

(i) A course on 'Number Systems' given by Dr. S.K. Gupta. The course was based on the book 'Number Systems' by Principal Shanti Narayan.

(ii) A course on 'Basic Mathematical Structures' given by Dr. R.K. Rathy. The course was based on the book 'Basic Mathematical Structures' by prof. J. N. Kapur

(iii) A course on 'Linear programming and Matrices' given by Dr. S. K Gupta. This was based on his own research work.

(iv) A course on 'Vector Analysis' was given by Dr. B. L. Bhatia. This was based on lecture notes 'Methods of Mathematical Physics' by Prof. J. N. Kapur.

(v) A short course on Fortran progamming for computers was given by Shri V. K. Srivastava.

(vi) Problem Solving Session was conducted by prof. J.N. Kapur. Fifty challenging problems were given to the students and their solutions were discussed in the class.

(vii) 'Discussion Session' was conducted by Prof. J.N. Kapur. About ten discussions were held on topics like 'Mathematics', 'Scientific Societies and their role', 'Plans for future study', 'what is topology?', 'Algorithms for HCF, LCM, Square root etc. in school Mathematics', Irrational numbers.

(viii) Special lectures by distinguished scientists and mathematicians were arranged.

(ix) Visits were organised to aeronautical engineering laboratories and computer centre.

Project Reports

In addition to the academic programme outlined above, special emphasis was laid on project-work by the students. Each of the 23 students completed a project during this time. Some of the projects were completely original and deserved publication, some were partially original and some others showed a remarkable capacity for assimilation of new ideas. Each student was given 15-30 minutes to present his or her project and most students showed a great confidence in presenting their projects. The following projects were completed by the students :

1. Groups of Symmetry
2. Magic Figures
3. Arithmetic in Binary System
4. Mathematical Induction
5. Lilavati

6. Graphs and their Uses
7. Transfinite Arithmetic
8. Why a fast bowler is able to swing the ball ?
9. Study of some Quadratic Diaphantine equations together with some particular Linear Differential Equations.
10. Graph Theory and its Applications.
11. Fun with Mathematics.
12. Some Mathematical Fallacies
13. Linear Programming
14. Arithmetic in Base '7' system
15. Study of Mathematics Journals
16. All about Divisibility.
17. Dynamic Programming.
18. Classification of Fallacies
19. Theory of Games
20. Study of Prime Numbers
21. An excursion into the World of Geometry.
22. Ancient Indian Contribution to Mathematics
23. A New Approach to Number System.

Special Lectures

Subject	*Speaker*
Basic Concepts of Modern Physics (2 Lectures)	Prof. J. Mahanty, Prof. of Physics, I.I.T., Kanpur.
Structural Organic Chemistry	Prof. C.N.R. Rao, Prof. of Chemistry, I.I.T., Kanpur
Integers as a source of research	Prof. I. N. Sinha, Assistant Prof. of Mathematics, I.I.T., Kanpur.
Algebra and Geometry	Prof. I. N. Sinha, Asst. Prof. of Mathematics, I.I.T., Kanpur.
Variational principles in heat transfer	Prof. H. L. Aggarwal, Asst. Prof. of Mech. Engg., I.I.T., Kanpur.
Non-Eucludian goeometry	Sri Richard A' Little, USA.
Topology	Sri Jon O. Herzog, U.S.A.
Some Interesting properties of numbers (4 lectures)	Shri D. R. Kaprekar, Devlali.

Introduction to aeronautics	Shri N. G. R. Iyenger, Aeronautical Engg. Deptt., I.I.T, Kanpur.

Summer School in Mathematics

Venue : Department of Applied Maths., Indian Institute of Science, Bangalore.

Director : Prof. P.L. Bhatnagar, Head of the Deptt. of Applied—Maths., Indian Institute of Science, Bangalore.

Duration : 15th May to 14th June, 1967.

The participants of the Summer School had completed the final year of the three-years B.Sc. course or its equivalent.

A series of exhaustive lectures were arranged on the following topics :

(a) Modern Algebra.
(b) Geometry from the unified point of view.
(c) Differential equations and special functions.
(d) Principles in Mechanics and special theory of relativity.
(e) Axiomatic treatment of probability theory, and Linear programming.
(f) Linear programming.

Some general lectures were also arranged on the following topics.

(i) Nature of Modern Mathematics and its impact on science.
(ii) What you should not do in Mathematics ?
(iii) The structure of matrix Algebra.
(iv) Recent developments in Astronomy.

Excursions were arranged to the following places of scientific interest :

(i) Indian Institute of science.
(ii) National Aeronautical Laboratory.
(iii) Hindustan Aeronautics Ltd.
(iv) Raman Research Industitute.
(v) Visweswaraiah Industrial and Technological Museum.
(vi) Hindustan Machine Tools.

STUDIES ON THIN LAYER CHROMATOGRAPHY

SUMMER SCHOOL
PROJECT REPORT
May, 1967

"THE AIM OF THIS PROJECT IS TO STUDY THE DIFFERENT TYPES OF ADSORBENTS TO TEST THEIR SUITABILITY FOR THIN LAYER CHROMATOGRAPHY"

SHAIKH K.K.A.R.
Science College,
Satara

DETAILS OF THE PROJECT

What is T.L.C.

Chromatography is an established technique for the separation of mixtures and for the purification of compounds.

Different types of chromotography such as column chromatography, paper chromatography, gas chromatography and thin layer chromatography are seen.

The term chromatography denotes a procedure in which a solution of substances to be separated is passed over a more or less finely divided organic or inorganic solid whereby retention of the individual components to different extents is obtained.

Thin layer chromatography is the most useful technique in the hands of chemists dealing with chemical analysis and seperations. It was described about twentyfive years ago by two Russian authors Ismailov and Shraiber but it was first introduced by G Stahl as a method for analytical adsorption chromatography. It was Stahl, who for the first time, described a practicable device for preparing layers of about 250 thickness on a special adsorbent 'kiesel gel G'. Thin layer chromatography has now become an elegent technique used most widely by modern chemists for analysis, seperation and isolation of different compounds.

Same conditions regarding physico-chemical principle apply to T.L.C. as to column chromatography becauce we deal, in both cases, with liquid-solid or liquid-liquid chromatography. The substance to be separated is extracted from a flowing liquid phase and retained on a solid phase or in a stabilized phase. In the first case we are concerned with adsorption while second case is a matter of partition chromatography.

General Techniques of T.L.C. :

T.L.C. involves three phases—the adsorbent which forms thin layer with the support of glass plates, the developing solvent in which the plate is dipped, and the substance to be resolved.

Layers of adsorbent approximately 250 μ thick are formed by a suitable method on 10 x 20 cm. or 20 x 20 cm. glass plates. Special spreader are used for this purpose. These spreaders may be of variable or fixed thickness. Using special trays and these spreaders the adsorbent is thinly applied on the glass plates. The plates are then activated by keeping them in specific temperatures (generally about 110° to 140°C). The spots of the substance to be resolved are then made at the lower edge of the layer with the help of micro-pipettes. This lower level is named as starting point (Fig. 1). After the solvent is evaporated, the plates are kept dipped vertically in the developing solvent, in the TLC jar or TLC chamber (Fig. 2).

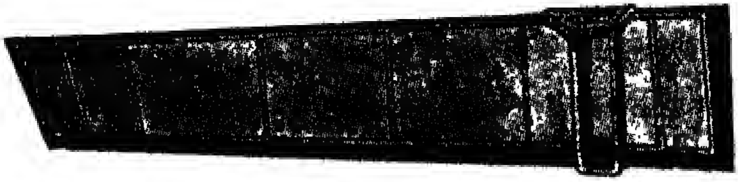


Fig. 1. Aligning Tray with spreader

Fig 2 Developing Jar

As the solvent moves up, the spots also move and by the principle mentioned before, the mixture gets separated into different spots. Coloured substances are easily seen on the plate but colourless substances are to be developed with special developers in order to make them visible. A list of the general solvents and developers is given later. The upper level (about 10 cms. from starting point) where the solvent reaches after some time is said to be the

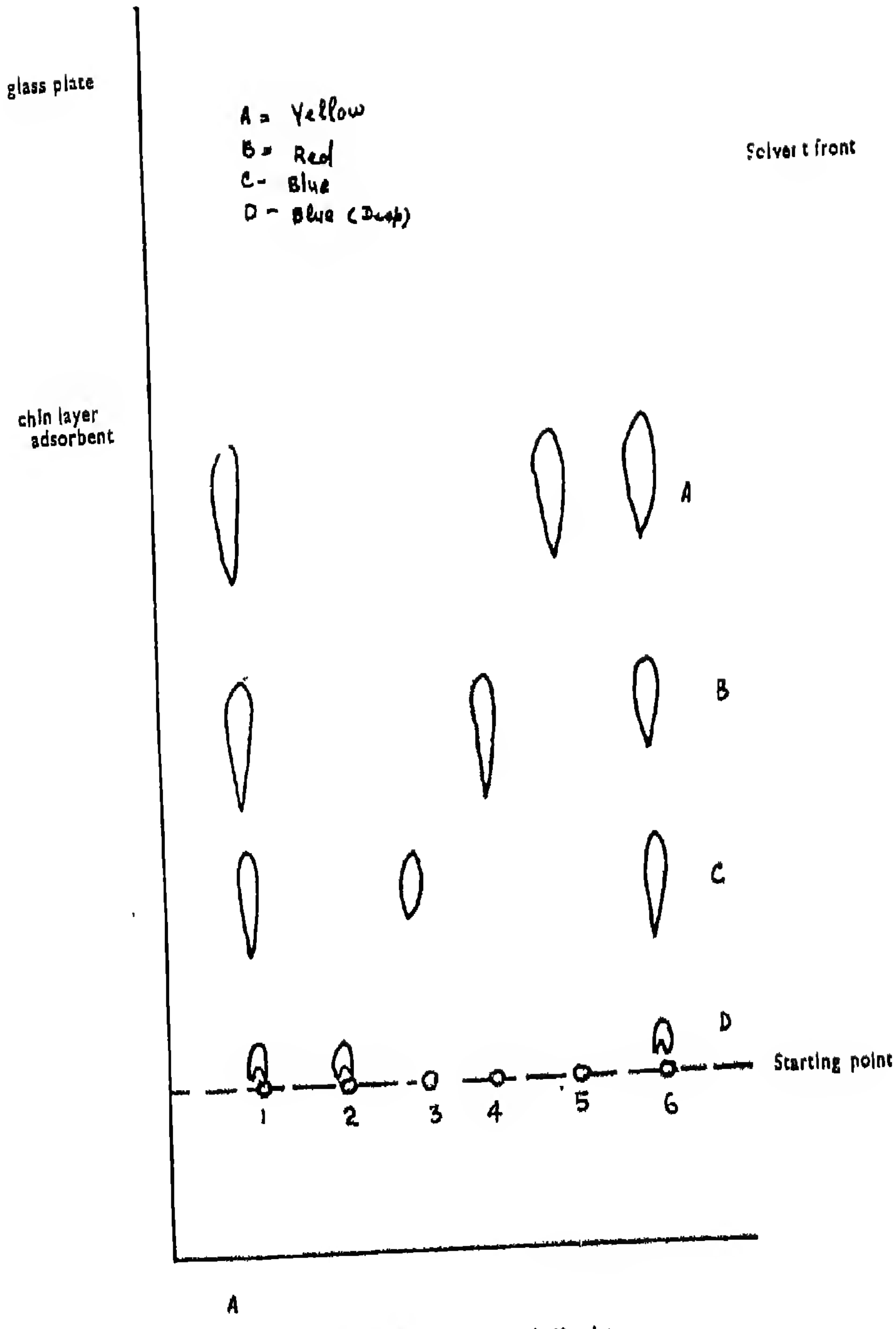


Fig. 3. Resolution on T. L.C. plate.

solvent front. The rate of advance of each compound in a given solvent is expressed in R_f values in paper chromatography. R_f can be defined as—

$$R_f = \frac{\text{distance of the substance from the start}}{\text{distance of the solvent from the start}}$$

In TLC, these values are expressed in terms of R_x or R standard values. The reference substance in these cases is supposed to have R_f value. Thus R st can be expressed as :

$$\text{R st. for } x = \frac{\text{distance of x from start}}{\text{distance of std. substance from start}}$$

Thus the resolution of a substance can be expressed in a statistical form with the help of these R st. values.

The separation of a substance in TLC can clearly be understood from a glance at Fig. 3.

Solvents generally used

(i) Petroleum ether.
(ii) Cyclohexane.
(iii) Carbon tetrachloride.
(iv) Benzene.
(v) Methylene chloride.
(vi) Chloroform.
(vii) Diphenyl ether.
(viii) Ethyl acetate.
(ix) Pyridine
(x) Acetone
(xi) n-Propanol.
(xii) Ethenol.
(xiii) Methenol.

Special features of TLC :

TLC became very popular within a few years because of its outstanding characteristics such as

(i) **Less time** :—The development in TLC takes place very quickly usually within a few minutes only. The time for resolution in TLC is just a fraction of what is needed in paper chromatography.

(ii) **Sharp resolution** :—It is found that the spots and their outline is more sharp in case of TLC. They can very easily be distinguished from each other. Even in closely spaced groups of spots, the sharpness increases the number of separately definable fractions.

(iii) **High Capacity** :—It is able to resolve as much as 100 milligrams of sample per plate which makes it particularly suitable for preparative fractionation.

(iv) **Versatility** :—TLC not only separates a wide and increasing variety of substances but also permits use of aggressive developing agents and strong measures to analyze sample components.

(v) **Operational simplicity** :—No great skill is needed to form layers of adsorbents, from paper thin to 2 mm. thickness, on supporting glass plates. Processing of the plates is simple because of their rigidity and convenient size.

Its usefulness and applications have surpassed almost all other chromatographic techniques.

TLC originally used in Terpene research is now extensively used for separation of liquids and is a valuable analytical procedure for numerous other substances. Because of its demonstrated advantages, it is a method of choice in many laboratories over-shadowing both paper and column chromatography.

TLC powerfully compliments gas chromatography. Preliminary fractionation by TLC reduces the complexity of a sample prior to resolution in gas chromatography. Judicious choice of adsorbents and developing solvent often will result in fractionation into classes of compounds.

The different absorbents used are lised below :

(i) Sil. gel

(ii) Sil. gel G

(iii) Florisil

(iv) Aluminium oxide G.

Aim of present work :

The most extensively used adsorbent is sil. gel G. The specially prepared sil gel G, which could fulfil the necessities of a TLC expt., is not available in India. It is to be imported from western countries. As it is imported it has become most expensive, though extensive. Its present price is about Rs. 100 per 500 gms. One can easily imagine how costly it is and how much expensive it has become to carry on any research dealing with TLC. Use of sil-gel is not only expensive but it also forms an outlet of our money to foreign countries. This loss of money cannot be controlled or stopped unless we ourselves produce sil. gel G. in our country. But our yearly requirement of the same being very small (just a few kilos), we cannot afford to start in the direction of production of sil. gel. G. here But if sil. gel. G. is replaced by some other cheap, easily available powder which also can give equally good results, the problem will be solved. It is this idea that struck and made me to take up this project.

Bearing the above ideas into mind, an attempt was made to use some powders and their suitability as plate material were investigated. Both the evenness of the plate and their resolving power were considered. The different adsorbents used were :

(i) Calcium carbonate.
(ii) Magnesium carbonate.
(iii) Barium carbonate.
(iv) Barium sulphate.
(v) Starch.
(vi) Kiesel guhr.
(vii) Magnesium carbonate mixed with sil. gel. G.
(viii) Starch mixed with magnesium carbonate.
(ix) Kaoline
(x) Kaoline mixed with Kiesel guhr.

Different binders such as calcium sulphate, starch solutions were also used. A number of developing solvents were employed to obtain better results. The observations and actual experiments are given later on.

An attempt to reactive spent sil. gel. G was also made. The used sil. gel G was subjected to a number of washing with different solvents. It was then dried and activated. Its results were compared with the original sil-gel-G.

Experimental Data :

(1) **Preparation of plates :**

(i) **Selection of powders :**—Powders were selected depending upon particle size, solubility etc. All insoluble powders were used. They were carbonates, sulphates etc.

(ii) **Sieving of powders:**—The powders were sieved through thin piece of cloth so as to maintain their particle size uniform. Powders of uniform particle size give an uniform layer on the glass plate and resolution is good in such uniform, smooth layers.

(iii) **Use of Binder :**—Binder is used to fasten the layer to the glass plate. Here for all above listed powders, except starch and kaoline-$MgCO_3$ mixture, calcium sulphate was used as binder. It was mixed with the powders in different proportions. The binder was also sieved through the same piece of cloth so as to keep the same size of the particles of binder as that of the powders.

(iv) **Spreading :**—The mixture of the powder and binder was suspended in distilled water and then spread over the glass plates using shando variable thickness spreader keeping the width 250 μ.

(v) **Activation :**—The plate was then allowed to dry a little and kept in oven at about 110°C. This makes the plate activated. The activated plates were then used for the experiments.

Silica gel-G plates :

These plates were used as standard plates.

The results of other plates were compared with these sil. gel. G plates

No.	Adsorbent powder	Binder	Water	Thickness (μ)	Temp- of activation	Time of act
1.	Sil-gel-G.	—	1 : 2	250	110°C	30 min.
2.	+$CaCO_3$ 87%	$CaSO_4$ 13%	1 : 2	250	110°C	,,
3.	$MgCO_3$ 90%	$CaSO_4$ 10%	1 : 2	250	110°C	,,
4.	$BaCo_3$ 90%	$CaSO_4$ 10%	1 : 2	250	110°C	,,
5.	$BaSO_4$ 90%	$CaSO_4$ 10%	1 : 2	250	110°C	,,
6.	Starch	Starch solution 1 : 1.5	—	250	Room temp.	,,
7.	Starch and Magnesium carbonate	$CaSO_4$ 10%	1 : 2	250	Room temp.	,, ,,
8.	Kiesel guhr 90%	$CaSO_4$ 10%	1 : 2	250	110°C	,,
9.	$MgCO_3$ + sil. gel. G.	$CaSO_4$ 10%	1 : 2	250	110°C	,,
10.	Kaoline	$CaSO_4$ 10%	1 : 2	250	110°C	,,
11.	Kaoline + kieselguhr	No binder	1 : 2	250	110°C	,,
	*$CuCO_3$ + $AgNO_3$	—				

* for hydrocarbons using their complexing property.

(2) **Resolution of different substances on plates :**

Four different classes of componds were subjected and used for resolution on these prepared plates. Different developing solvents were used. The compounds used were :

(i) Hydrocarbons—(a) Anthracene.

(b) Acenaphthene.

(c) Naphthlene.

(d) Eugenol methyl ether.

(e) Diphenyl

(ii) D.N.P. derivatives—

(a) Acetone
(b) Vaniline
(c) Acetophenone.

(iii) Sugars— (a) Glucose
(b) Lactose
(c) Maltose

(iv) Dyes— (a) Sudan III
(b) Azobenzene
(c) Fat colour yellow.

OBSERVATIONS AND OBSTACLES

1. Developing of sugar sports with suitable developers :

N/10 $AgNO_3$ solution was used as developer for sugars. Actually ammonical $AgNO_3$ is used for the same but in $MgCO_3$ plate, the plate was first sprayed with N/10 $AgNO_3$ soln. and then exposed to ammonia. The spots became visible. No ammonical $AgNO_3$ was needed.

The above process of developing failed in the developing of sugar spots on sil-gel-G plate. No spots were visible by above process. So the plate was exposed to Iodine vapours, and it was unexpectedly found that the spots became clearly visible. So in some carbonate plates, iodine can be used as developer for sugars.

2. Preparation of starch plate :

Starch and sugars both contain a no. of hydroxyl group. So an attempt was made to resolve sugars on starch plates.

Binder for starch :—A small amount of thick paste of starch was suspended in hot water. The water was boiled for a while and then cooled. This 100 c. c. of starch solution was used as the binder for starch in proper proportions.

Activation of starch plate :—The starch plate was found cracked after activation at 110°C. So it was then activated (dried) in air only (at room temp.). Then also it was found cracked. A small percentage (20%) of $MgCO_3$ was then added to starch in order to save the plate from cracking. The cracking in this plate was reduced but no good results could be obtained. Starch is unsuitable as an adsorbent in TLC.

3. Sugar resolution on coated kiesel ghur plate :

Since the kiesel ghur was not given good resolution, it was coated with

water and ethyl glycerol (80 : 20%) and then it was subjected to TLC using water saturated butanol as the solvent.

4. **Recovery of used silica gel G :**

This was rather a side attempt to see whether same silica gel, after proper washings, could be used again and again.

About 10 gms. of used sil. gel. G was collected. It was washed with water a no. of times so as to remove any soluble impurity, if any. It was then extracted with methenol and washed with the same for three times. A series of chloroform washningswas done then. The powder was kept in a porcelain dish and chloroform was allowed to go off. This powder was then heated to 110° C and then activated at 210°C for half hour. Plates were prepared from this recovered sil. gel. G and subjected to experiments. The results are given in the table.

5. **Activation of $CaCO_3$ plate by $AgNO_3$:**

The calcium carbonate plate was observed not to give good resolution of hydrocarbons. It was then activated by $AgNO_3$.

5 gms. of $AgNO_3$ dissolved in 50 c.c. was taken in the TLC jar and the plate was dipped in it. The $AgNO_3$ soln. was allowed to move right upto the top of the plate. The plate was then taken out, dried and then subjected to resolution of hydrocarbons.

Similarly sil-gel G plate was also activated with $AgNO_3$ and used for hydrocarbon resolution.

OBSERVATION TABLES

(A) Resolution of Hydrocarbons

No.	Date	Plate material	Sub. Resolved	Solvent	Developer	Time	Rf values	Remarks
	2	3	4	5	6	7	8	9
1.	10–5-1957	Silica gel G.	(i) Anthracene (ii) Naphthalene (iii) Acenaphthene	Petroleum ether 100% (60-80°)	Iodine	50 min.	—	Good resolution. This can be taken as the standard. But Naphthalene and Acenaphthene move almost the same distance.
2.	12–5–67	Sil. gel. G.	(i) Anthracene (ii) Mixture of i & iii	Pet. ether 100%	Iodine	60 min.	—	Resolution not satisfactory. The plates should be activated by solvents such as $AgNO_3$.
			(iii) Anthracene				—	
3.	13-5-67	Sil-gel-G activated with $AgNO_3$	(i) Anthracine (ii) Acenaphthene	Pet. Ether 100%	Iodine	65 min.		Resolution not satisfactory.
4.	15–5-67	$CaCO_3$	(i) Anthracene (ii) Acenaphthene	Pet. Ether 100%	Iodine	50 min.	—	No resolution. Spots move upto the solvent. Activation with $AgNO_3$ may lead to good result.
5.	15-5-67	$CaCO_3$ activated with $AgNO_3$	(i) Anthracene (ii) Acenaphthene	Pet. Ether 100%	Iodine	60 min.	—	No resolution. Spots move upto the solvent. This plate is unsuitable for hydrocarbons.

1	2	3	4	5	6	7	8	9
6.	17-5-67	$MgCO_3$	(i) Anthracene (ii) Acenaphthene	Pet. Ether 100%	Iodine	50 min.	—	Spots move upto the solvent front. So this plate is not suitable for hydrocarbon resolution.
7.	24-5-67	$MgCO_3$ (50%) + Sil. Gel-G (50%)	(i) Anthracene (ii) Acenaphthene	Pet. Ether 100%	Iodine	46 min.	—	No resolutions. Plate unsuitable for hydrocarbons.
8.	24-5-67	Starch	(i) Anthracene (ii) Acenaphthene	Benzene 100%	Iodine	30 min.	—	No resolution at all due to the cracked plate.
9.	24-5-67	Starch 80% + $MgCO_3$ 20%	Hydrocarbons	Benzene	—	30 min.	—	No resolution at all. The spots get spray spread on the plate.
10.	25-5-67	$BaCO_3$	(i) Anthracene (ii) Acenaphthene.	Petroleum ether 100%	Iodine	45 min.	—	No good resolution. Spots move upto the solvent front. The plate is not suitable.
11.	25-5-67	Kieser ghur	(i) Anthracene (ii) Acenaphthene	Petrol	Iodine	30 min.	—	No resolution at all. The plate is also not suitable for hydrocarbons.
12.	30-5-67	Kaoline + $CaSO_4$	(i) Anthracene (ii) Acenaphthene	Petroleum ether 100%	Iodine	40 min.	—	The devloping solvent does not move up since the adsorbent is very firmly stuck to the glass plate.
13.	31-5-67	Kaoline 83% + Kiesel ghur 20%	(i) Anthracene (ii) Mixture i & iii. (iii) Acenaphthene	Pet. ether 100%	Iodine	60 min.	—	Good resolution. Especially the mixture is separated nicely. The individuals can be clearly distinguished. The adjustment in percenta.e of kiesel guhr in kaoline will lead to better results.

(B) Resolution of D. N. P. Derivatives of Acetone, vanilline and Acetophenone

No.	Date	Material	Sub-resolved	Solvent	Developer	Time	Rx values	Remarks
1	2	3	4	5	6	7	8	9
14.	15–5-67	Silica gel G	D.N.P. derivatives	Benezene 90% Acetone 10%	self	35 min.	a) 1 b) 0.6 c) 0.17	
15.	15-5-67	$CaCo_3$	D.N.P. derivatives	Benezene 100%	self	50 min.	a) 1 b) 1.001 c) 0.35	Diffused spots. No good resolution.
16.	18-5-67	$MgCo_3$	D.N.P. derivatives of a) Acetone b) Vanilline c) Acetophenone	Benezene 90% Acetone 10%	self	55 min.	a) 1 b) 0.94 c) 0	Two spots except vinilline more. There is no resolution of vanilline. So this plate is unsuitable for vanilline. Other two spots are round and small.
17.	19-5-67	$BaCo_3$	D.N.P. derivatives a) Acetylene b) Acetone c) Vanilline	Benezene 90% Acetone 10%	self	60 min.	a) 1 b) 1.01 c) 0.04	Spots are round and small but thev move upto the solvent front. Vanilline derivatives also move a little. This plate is better than $MgCo_3$.
18.	22-5-67	Sil-gel G 50%+ $MgCo_3$ 50%	D.N.P. derivatives.	Benzene 90% Acetone 10%	self	55 min.	(a) 1 (b) 1 (c) 0.3	D.N.P. derivatives of Acetone & Acetophenon move right up to the front Vanilline moves a little. This plate may stand good for resolution of phenolic D.N.P. derivatives.

1	2	3	4	5	6	7	8	9
19.	24-5-67	Starch	D.N.P. derivatives	Benezene 90% Acetone 10%	self	10 min.	—	No. resolution. unsuitable.
20.	24-5-67	Starch+ $MgCO_3$ 20%	-do-	Benezene 100%	self	10 min.	—	No resolution. Unsuitable plate.
21.	25-5-67	Kiesel guhr.	-do-	Benezene 90% Acetone 10%	self	25 min.	—	Spots move upto the front. Unsuitable.
22.	25-5-67	Kiesel guhr.	-do-	Benzene 100%	self	35 min.	—	Spots move upto the front. Vanilline shows tailing. Plate unsuitable.
23.	30-5-67	Kaoline	-do-	Benzene+ ethylacetate 5%	self	60 min.	(a) 1 (b) 0.09 (c) 0.3	Substance resolves but adsorbent being very firmiy bounded, the developing solvent does not rise up. Binder should be reduced.
24.	31-5-67	Kaoline 80%+ Kiesel guhr 20%	D.N.P. derivatives.	Benzene+ ethylacetate 5%	self	50 min.	(a) 1 (b) 0.35 (c) 0.1	
25.	1-6-67	Recovered sil-gel-G	do	Benzene 90% Acetone 10%	self	40 min.	(a) 1 (b) 0.68 (c) 0.28	

(C) Resomtion of sugars—(i) glucose (ii) Lactose (iii) Maltose

No.	Date	Plate material	Substance resolved	Solvent	Developer	Time	R_g value R. glucose	Remarks
1	2	3	4	5	6	7	8	9
26.	18-5-67	Sil-gel-G.	Sugars : i) glucose ii) Lactose iii) Maltose	Chloroform 90% Methenol 10%	I_2	65 min.	R_g i) 1 R_g ii) 0.51 R_g iii) 0.95	Resolution not satisfactory. Tailing and diffuse spots obtained.
27.	18-5-67	$MgCO_3$+ $CaSO_4$	Sugars : i) glucose ii) Lactose iii) Maltose	-do-	$AgNO_3$+ NH_3	65 min.	R_g i) 1 R_g ii) 0.33 R_g iii) 0.23	No good resolution; unsuitable for sugars; can be developed with I_2 also.
28.	18-5-67	$BaCO_3$+ $CaSO_4$	-do-	Chloroform 60% methanol 40%	I_2	2 hours	R_g i) 1 ii) 0.56 iii) 0.44	Diffused spots obtained; $BaCO_3$ not suitable for sugar resolution. Changed percentage of solvent does not make any change.
29.	18-5-67	$BaCO_3$+ $CaSO_4$	Sugars i) glucose ii) lactose iii) maltose	Chloroform 90% Methanol 10%	I_2	2 hours	R_g i) 1 ii) 0.19 iii) 0.38	Plate is unsuitable for sugar resolution.
30.	20-5-67	$CaCO_3$+ $CaSO_4$	-do-	-do-	I_2	60 min.	R_g i) 1 ii) 0.31 iii) 0.43	
31.	22-5-67	Sil. Gel. G 50% +$MgCO_3$ 20%	Sugars	-do-	I_2 $AgNO_3$+ NH_3	50 min.	—	No resolution at all. This plate is unsuitable for sugar resolution.
32.	22-5-67	Starch 80% +$MgCO_3$ 20%	Sugars	-do-	I_2	15 min.	—	No resolution at all. Plate unsuitable.

1	2	3	4	5	6	7	8	9
33.	25-5-67	Kiesel ghur	Sugars	-do-	$AgNO_3+NH_3$	35 min.	—	No resolution. Spots move upto the front and get mixed. Some material on the plate is needed in order to check this speed.
34.	27-5-67	Kiesel ghur	Sugars	Saturated Butanol	$AgNO+NH_3$	30 min.	—	No resolution obtained, so this plate is unsuitable for sugar resolution.
35.	27-5-67	Kiesel ghur	Sugars	Saturated Butanol	$AgNO_3+NH_3$	35 min.	—	No good resolution but the special feature of this plate is that a round spot of glucose is obtained which is not seen in any other plate.
36.	27-5-67	Kiesel ghur Dipped in ethylene glycol.	Sugars	Ethyl acetate	-do-	—	—	No resolution, so kiesel guhr plates are unsuitable for sugar resolution.
37.	30-5-67	Kaoline	Sugars	Chloroform 90% Methanol 90%	-do-	1 hr.	—	Adsorbent is firmly attached the plate and does not allow the solvent to move up. Addition of some other more polar powder may give good result.
38.	31-5-67	Kaoline+ Kieselguhr 20%	Sugars	-do-	-do-	—	—	No resolution. This plate is unsuitable for sugars.

(D) Resolution of Dyes :— (i) Sudan III (ii) Azobenzene (iii) Fat colour yellow

No.	Date	Material	Substance Resolved	Solvent	Developer	Time	Std. Rs	Remarks
39.	16-5-67	Sil-gel-G.	a) Sudan III b) Congo red c) fat colour yellow.	Benzene 80% Acetone 20%	Self	35 min.	Rs a) 1 Rs b) 0 Rs c) 0.88	Congo red does not move. Plate unsuitable for congo red.
40.	16-5-67	$CaCO_3$	-do-	Benzene 100%	Self	50 min.	Rs a) 1 Rs b) 0 Rs c) 0.	This plate is also unsuitable for congo red. Some other dye give resolution.
41.	17-5-67	$MgCO_3$	a) Sudan III b) Azobenzene c) Fat colour yellow	Benzene 50% Petrol 50%	Self	60 min.	Rs a) 1 Rs b) 1.15 Rs c) 0.74	Azobenzene resolves better than congo red. Changed percentage on solvent gives better result.
42.	19-5-67	$BaCO_3$	-do-	-do-	Self	60 min.	Rs a) 1 Rs b) 1.06 Rs c) 0.74	Spots are clear and sharp. Migration is good. Thit plate may give better results after alternation of solvent of its percentage.
43.	20-5-67	Sil-gel-G	Dyes : a) Sudan III b) Azobenzene c) Fat yellow	Benzene 100%	Self	80 min.	Rs a) 1 Rs b) 3.3 Rs c) 0.26	Good resolution.
44.	20-5-67	$CaCO_3$	Dyes : a) Sudan III b) Azobenzene c) Fat colour yellow	Benzene 100%	Self	60 min,	Rs a) 1 Rs b) 1.07 Rs c) 0.3	Resolution is not so good compared to sil-gel-G. But fat yellow is resolved into two spots whereas sil-gel-G shows only one spot. This is remarkable that this plate shows least impurity, if any.
45.	22-5-67	Sil-gel-G 50%+ $MgCO_3$ 50%	-do-	-do-	Self	65 min.	Rs a) 1 Rs b) 2.3 Rs c) 0.36	Good resolution. Dark, round and sharp spots obtained.
46.	31-5-67	Kaoline 50% +Kiesel guhr 50%	-do-	Benzene+ ethyl acetate.	Self	90 min.	Rs a) 1 Rs b) 1.18 Rs c) 0.54	Resolution takes place but the solvent does not move up.

Conclusion :

Looking to the number of results obtained in these experiments one can say and find that no other material can give better or at least as good results as the sil-gel G. So silica gel G still remains the universal and unchallanged material for TLC. But these attempts to find some other adsorbents has certainly not failed completely, Though unable to be used for almost all compounds, some of the materials do pro nise good resolution and better results in some specific cases.

The separation of hydrocarbons mixture, which is not clear even in sil-gel G plate, is observed wonderfully good in the adsorbent Kaoline mixed with kieselguhr. The idea can be more clear on comparing picture slips no 2 and 3.

Glucose, which shows failing even in sil. gel G plate is resolved in a round spot in kieselguhr plate.

The want of sil-gel G can be lessened by mixing some other suitable adsorbent (cheaply available) with it in different proportions so as to get equally fair results.

It is also suggestive that the experiments with starch and Kaoline 100% will save the time of future workers in this direction since these materials are most unsuitable to be used as adsorbents in TLC.

The most inspiring result in these attempts which, I hope, will attract the attention and concentration of the workers in this field is the successful recovery of used sill-gel G. It is found that the used sill-gel G can be recovered and used with slight loss of efficiency. Comparing the Rf values of the original sil-gel-G and the recovered one, one can easily see the success of the attempt. The Rf values are once again given here for a glance over.

The environmental conditions, solvent, developer and resolved substances are same for both plates.

No.	Material	Resolution of	Rf Values
1.	Sil. gel G	D. N. P. dervatives of a) Acetone b) venilline c) Acetophenone	R acp a) 1 R acp b) 0.6 R acp c) 0.17
	Recovered Sil. gel G	—do—	R acp a) 1 R acp b) 0.68 R acp c) 0.28
2.	Sil-gel G	Hydrocarbon i) Anthracene ii) Mixture iii)Acenaphthene.	R acp iii) 1 R acn i) 0.7058
	Recovered Sil-gel G	—do—	R acn iii) 1 R acn i) 0.8

A little more effort in the direction will surely lead to the substance which could replace sil-gel G at least in some specific cases and trying with some more lab. ways it would be possible to use the same used sil-gel G again and with the same efficiency as the original one.

APPENDIX II

SAMPLE ITEMS FROM SCIENCE APTITUDE TEST, 1967
PART—A (THOUGHT TYPE)

PHYSICS

Section 1

A merry-go-round rotating at constant speed makes one complete rotation every ten seconds. It has a ring of horses mounted at a distance of 20 feet from the centre and a ring of swans mounted at a distance of 10 feet from the centre. The frequency of any rotating object is defined as the number of revolutions that the object makes per unit time.

QUESTIONS ON SECTION 1

1. What is the frequency at which the horses are rotating ?

1. 1/10 rev. per sec. ☐
2. 1/2 rev. per sec. ☐
3. 1 rev. per sec. ☐
4. 10 rev. per sec. ☐

2. The ratio of the frequency of rotation of horses to that of the swans is

1. 1 : 1 ☐
2. 2 : 1 ☐
3. $\sqrt{2} : 1$ ☐
4. 1 : 2 ☐

3. What is the ratio of the speed of the horses to that of the swans ? (both relative to the ground)

1. 1 : 2 ☐
2. $1 : \sqrt{2}$ ☐
3. $\sqrt{2} : 1$ ☐
4. 2 : 1 ☐

4. If the frequency of the merry-go-round is f and the distance of the horses from the centre is r, what is the area swept out per unit time by a line connecting horse to the centre ?

1. πrf ☐
2. $\pi r^2 f$ ☐
3. $2\pi r^2 f$ ☐
4. $\pi r^2 f^2$ ☐

CHEMISTRY

Section 2

The decay of organic matter is generally caused by activity of different living organisms, like bacteria. When vegetable matter decays in air, all of its carbon content is finally converted into carbon dioxide. When the decay occurs under water, as in swamps, it produces methane.

QUESTIONS ON SECTION 2

5. This is so because

   1. oxygen is only slightly soluble in water and the total amount available to promote decay is inadequate for the oxidation of all the carbon ☐
   2. the chief factor in promoting the two different kinds of decay is the difference in the kind of bacteria found in air and in water ☐
   3. the percentage of hydrogen is greater in water than in air and a large part of the carbon of the vegetable matter, therefore, combines with this element ☐
   4. there is enough oxygen in air and abundance of hydrogen in water ☐

BIOLOGY

Section 3

The bud of the opium poppy throws off the green calyx which sheaths it and the shining corolla spreads out to the sun. In the heart of the flower stands the pistil surrounded by numerous stamens. The ripe stamens allow the fine pollen dust to escape. The dust is made up of thousands of microscopic grains. At the top of the pistil, like the spokes of a wheel, are the black bands of the stigmas. Pollen, which has fallen on the stigmas, remains imprisoned on the papillae. The septate ovary contains hundreds of translucent ovules. From each pollen grain issues a fine tube which penetrates the ovary to fertilize an ovule. The flower droops ; stamens and petals disappear ; the fertilized pistil remains. The sole survivor of the withered flower, the pistil, day by day changes into a fruit. The ovules have become seeds.

QUESTIONS ON SECTION 3

6. The pollen dust is produced in the

   1. stigmatic papillae ☐
   2. pistil ☐
   3. stamen ☐
   4. ovule ☐

7. After fertilization is over in plants

   1. the pollen issues a pollen tube ☐
   2. the plants wither ☐
   3. the ovary falls ☐
   4. the ovules are transformed into seeds ☐

MATHEMATICS

Section 4

A centre of any geometrical object which may consist of a number of points, lines, circles etc is a point O, possessing the following property. If P is any point of the geometrical object and P′ is the point on PO produced such that P′O=OP, then P′ should also be a point of the geometrical object ; with this definition, a circle or a sphere has only one centre which is its centre in the usual sense. A geometrical object may not have any centre at all, may have one unique centre, or may have more than one centres.

QUESTIONS ON SECTION 4

8. A square has

   1. one unique centre ☐
   2. no centre ☐
   3. an infinite number of centres ☐
   4. four centres ☐

9. A pair of intersecting straight lines (produced indefinitely in both directions) has

   1. no centre ☐
   2. a unique centre ☐
   3. two centres ☐
   4. an infinity of centres ☐

10. A pair of parallel lines has

    1. no centre ☐
    2. one centre ☐
    3. two centres ☐
    4. an infinity of centres ☐

11. Three mutually parallel lines lying in a plane have

    1. always one centre ☐
    2. no centre at all, in any case ☐
    3. may have an infinity of centres in some cases ☐
    4. will always have an infinity of centres ☐

AGRICULTURE

Section 5

Four forms of water are known to exist in the soil. Gravitational water percolates downwards through the subsoil. Capillary water is held by the soil against the pull of gravity and moves in any direction in response to capillary tension. Hygroscopic water is firmly retained by an air-dry soil. Combined water is held in chemical combination after the hygrospopic water has been removed.

QUESTIONS ON SECTION 5

12. The main source of water available to plants is

    1. gravitational water ☐
    2. capillary water ☐
    3. hygroscopic water ☐
    4. combined water ☐

ASTRONOMY

Section 6

At the beginning of its life a star is simply a condensation of interstellar gas and dust, large in size, relatively cold throughout its material, and low in density. The condensation is held together by its own gravitation and may be aided by the pressure of hot, ionised hydrogen from its surroundings. The condensation contracts, becomes hotter and denser inside. Ultimately, it starts to glow and a star is born.

QUESTIONS ON SECTION 6

13. During the stage of contraction, a star is

    1. collapsing in size, largely under its own gravitation ☐
    2. collapsing in size, largely under the pressure of outside gases ☐
    3. losing its mass rapidly ☐
    4. getting cooler ☐

14. The raw material for the building up of a star is

    1. ionised hydrogen ☐
    2. gravitational force ☐
    3. interstellar gas and dust ☐
    4. condensed water ☐

BIOPHYSICS

Section 7

When certain radioactive atoms are introduced into the human system, they go to the specific places in the body and the average time of their stay can

be found out from the measurement of radiation which the radioactive substance gives off. Administration of compounds of radioactive iodine I^{131}, followed by external measurements of radioactive emanations in the thyroid region of the neck can determine whether the thyroid is normal, over, or under active. A hyperactive thyroid may absorb upto 80% of the iodine ; a hypoactive thyroid may absorb as little as 15%.

QUESTIONS ON SECTION 7

15. Which one of the following statements is correct ?

1. large amounts of radioactive emission indicates hypothyroid activity ☐
2. small amounts of radioactive emission indicates hyperthyroid activity ☐
3. a hyperactive gland gives (when it absorbs radioactive iodine) about five times as much radioactive emission as a hypoactive gland ☐
4. a hyperactive gland (when it absorbs radioactive iodine) gives about half as much of radioactive emission as does a hypoactive gland ☐

16. Which one of the following statements is true ?

1. I^{131} is not useful for finding thyroid defects ☐
2. I^{127} is not useful for finding out thyroid defects ☐
3. normal thyroid is hyperactive ☐
4. normal thyroid is hypoactive ☐

PART B

PHYSICS (FACTUAL TYPE)

1. Give another name for "the smallest part of an element capable of taking part in a chemical reaction".

(*i*) an electron ☐
(*ii*) a proton ☐
(*iii*) an atom ☐
(*iv*) a molecule ☐

2. At what angle to the horizontal should a ball be kicked to attain maximum distance ?

(*i*) 0° ☐
(*ii*) 90° ☐
(*iii*) 30° ☐
(*iv*) 45° ☐

3. Lenz's Law is a consequence of the law of conservation of

   (*i*) charge ☐
   (*ii*) momentum ☐
   (*iii*) mass ☐
   (*iv*) energy ☐

4. A charged particle moves through a magnetic field. The effect of the field is to change the particle's

   (*i*) direction of motion ☐
   (*ii*) mass ☐
   (*iii*) speed ☐
   (*iv*) energy ☐

5. It is possible to measure the passage of 50 electrons per second with a certain sensitive device. This corresponds to a current of approximately

   (*i*) $8{\cdot}0 \times 10^{18}$ amp. ☐
   (*ii*) $1{\cdot}6 \times 10^{-20}$ amp. ☐
   (*iii*) $8{\cdot}0 \times 10^{-20}$ amp. ☐
   (*iv*) $1{\cdot}6 \times 10^{-18}$ amp. ☐

6. The electric field intensity at a point in space is equal in magnitude to

   (*i*) the potential difference there ☐
   (*ii*) the electric charge there ☐
   (*iii*) the force, a unit charge would experience there ☐
   (*iv*) the force, an electron would experience there ☐

CHEMISTRY

(FACTUAL TYPE)

7. Reaction between neutral solution of barium chloride and sodium carbonate goes to completion because

   (*i*) a gas is formed ☐
   (*ii*) the reaction is reversible ☐
   (*iii*) barium carbonate is insoluble ☐
   (*iv*) sodium chloride is more stable than sodium carbonate ☐

8. Sodium bicarbonate is an important constituent of

   (*i*) caustic soda ☐
   (*ii*) washing soda ☐
   (*iii*) baking powder ☐
   (*iv*) soaps ☐

9. Which of the following property is different for neutral atoms of the two isotopes of the same element ?

(*i*) atomic number ☐
(*ii*) atomic weight ☐
(*iii*) number of electrons ☐
(*iv*) number of protons ☐

10. Consider the following data :

Element	*Atomic Weight*
A	12·0
B	35·5

A and B combine to form a new substance X. If four moles of B combine with one mole of A to give one mole of X, then the weight of one mole of X is

(*i*) 47·5 g. ☐
(*ii*) 83·0 g. ☐
(*iii*) 154·0 g. ☐
(*iv*) 166·0 g. ☐

BIOLOGY

(FACTUAL TYPE)

11. Although the potato tuber has no chlorophyll, it contains lot of starch because

(*i*) it synthesizes starch in the absence of chlorophyll ☐
(*ii*) the sugar is translocated from the leaves to the tuber ☐
(*iii*) it is a modification of the stem which already contains starch ☐
(*iv*) certain soil bacteria manufacture and deposit starch in them ☐

12. During snow-fall the plants

(*i*) do not respire ☐
(*ii*) do not photosynthesize ☐
(*iii*) show maximum transpiration ☐
(*iv*) show minimum life functions ☐

13. The fungal diseases are usually more prevalent in

(*i*) desert areas ☐
(*ii*) wet weather ☐
(*iii*) fruit trees ☐
(*iv*) extremely cold climate ☐

14. If a man is suffering from deficiency of vitamin C, he should eat or drink

(i) lot of eggs
(ii) plenty of lime juice
(iii) sufficient quantity of groundnuts
(iv) a glass of mango juice every day

15. Which of the following groups of plants contain chlorophyll ?

(i) bacteria
(ii) algae
(iii) fungi
(iv) all of the above

MATHEMATICS

(FACTUAL TYPE)

16. The number of permutations of the letters of the word CLASSES, taken all together is

(i) $|\underline{4} \times {}^6C_3$
(ii) $|\underline{7} - |\underline{6}$
(iii) $|\underline{7} - |\underline{5}$
(iv) $\dfrac{|\underline{7}}{|\underline{3}}$

17. The line $50x-48y+7=0$, is drawn in the Cartesian plane of the four points

(0,0) ; (5 5) ; (4,5) ; (3,6)

(i) all lie on the same side of the line
(ii) three of them lie on one side and one on the other
(iii) two of them lie on one side and two on the other
(iv) some lie on the line

18. The function $f(x) = 7-2x-3x^2$ for real values of x, has

(i) a maximum which is positive
(ii) a maximum which is negative
(iii) a minimum which is positive
(iv) no minimum or maximum

19. Of the following four functions defined in the interval (0,1)

$\text{Sin}\,\dfrac{\pi x}{2}$; $\text{Cos}\,\dfrac{\pi x}{2}$; $\dfrac{x}{1-x}$; $\text{Sin}\,\pi x$

(*i*) all are increasing

(*ii*) two are increasing and one is decreasing

(*iii*) two are decreasing and one is increasing

(*iv*) three are increasing and one is decreasing

20. The equation

$$3 \operatorname{Sin} \theta + 4 \operatorname{Cos} \theta = a,$$

has real solutions in θ, only when

(*i*) $a > 0$

(*ii*) $a \geqslant 0$

(*iii*) $|a| \leqslant 5$

(*iv*) $|a| < 5$

APPENDIX III

SAMPLE TOPICS OF ESSAY TYPE TEST

Time—2 hours *Maximum Marks—50*

Note : Write an essay on *any one* of the following topics in about 2,000 words. Diagrams should be presented, whereever necessary, to illustrate the answer. The essay may be written either in *English* or in a *regional language.*

1. Artificial fibres.
2. Food and fitness.
3. Interdependence of plants and animals.
4. Measurement of time.
5. The conquest of space.
6. The role of science in economic development.

PROJECT REPORT

APPENDIX IV

PROJECT REPORT

Roll No. 15911

Investigation of the variation of the intensity of sunlight using a Solar Cell.

I Problem :

The energy of the Sun is used to illuminate our globe. The earth receives only a minute fraction of the total solar light energy. It is estimated that the earth intercepts only 5×10^{-10} per cent of the total radiation. Again this small percentage of the solar radiation varies from morning to evening daily and there is monthly variation and also there is seasonal variation.

In this investigation, variation of intensity from morning to noon and from noon to evening is studied. An attempt is also made to correlate the intensity of sunlight at a given time for a few days in the week.

The advent of the solar cell during the last few years has made this study possible.

II Method of Investigation :

A solar cell which gives a high open circuit out-put voltage was used. The cell was first mounted on an optical bench and its response to the illuminations of 15, 25, 40, 60 and 100 watt coiled coil filament lamps, all made by the same firm, ("Bengal Lamp Works") was studied for various distances of the cell from the lamps. For this study, a Weston galvanometer was connected across the terminals of the solar cell and deflections of the galvanometer are recorded. The deflections were plotted against the wattage of the lamps for various distances. The graphs obtained were straight lines indicating the linear relationship existing between wattage of the illuminant and the response of the solar cell.

To keep the deflections of the galvanometer on the scale, two methods were tried (i) The galvanometer was shunted with a low resistance. As we do not have very low standard resistances, this method was partially used. The intensity of the sunlight is of such tremendous magnitude that the approach to the problem cannot be altogether successful by this method ; (ii) Ground glass plates 10cm $\times$ 7cm and thickness 0.32 cm were used as light filters to diminish the intensity of sunlight falling on the solar cell. The fractional transmission of the filters were studied using a 100 watt lamp. In addition to these filters, a shunt of 0.5 is used across the galvanometer.

The sensitivity of Weston galvanometer of different manufacturers were studied. A galavanometer of low sensitivity was used in the investigation as it was found that the deflections of the more sensitive ones could not be easily controlled.

The solar cell was mounted on a pedestal at a distance in front of the laboratory and the galavanometer and its accessories were kept in the varandah

in a shaded place. The arrangements are shown in the photograph. The deflections of the galvanometer are noted every half an hour, using the appropriate ground glass filters.

In addition to the ground glass light filters, Red, Green, Yellow and Blue colour glasses were also used as colour filters and corresponding deflections were also noted.

III Experimental details of components

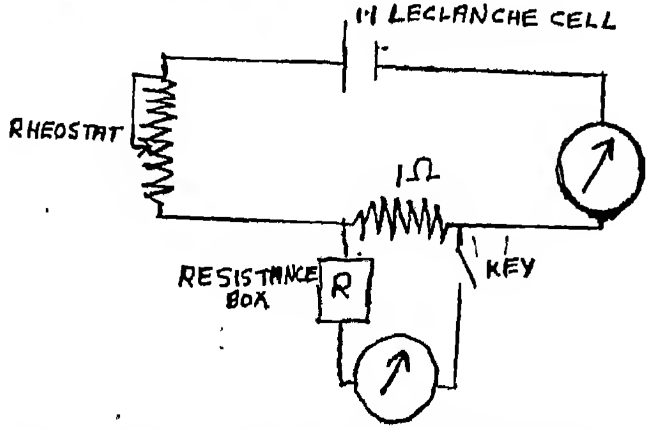
(a) *Description of the solar cell used* :

A solar cell consists of razor—thin strips of silicon about one thousandth of an inch thick and it is doped with boron impurity. The performance of the solar cell is that it gives photoelectric power conversion efficiencies in sunlight of around 7 to 8 per cent. This figure is about an order of magnitude higher than for any previous light converter and even exceeds by a large factor the efficiency of the photo-synthetic fixation of solar energy in the leaves of living plants A hundred of solar cells are needed to make a torch bulb glow[1] and 50,000 solar cells covering the area of a small room would only produce a kilowatt of electricity.

The solar cells convert the energy of the sun rays photoelectrically into electrical energy.

(b) *Choice of the Galvanometer.*

(1) Determination of the resistance of a Galvanometer.

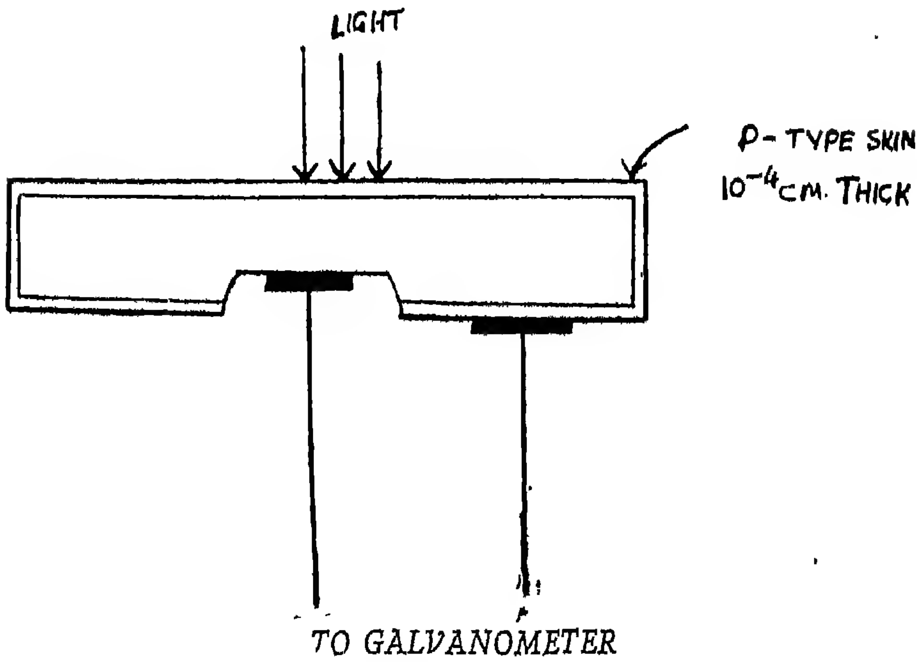


The circuit diagram showing the connections is shown above. The key is plugged in and the resistance of the rheostat is adjusted so that there is a particular reading in galvanometer. The potential difference between the two terminals of the one-ohm resistance will always be the same. Now the resistance of the resistance box R is adjusted so that the galvanometer reads exactly half of its original reading. Since the current has become half, the resistance is doubled because the potential difference has to be constant. The resistance

1. One hundred solar cells would produce enough voltage to make a torch bulb glow.

SOLAR CELL

Size—0.57 of the Original Size. To give an indication of the Size of the cell, a scale marked in centimeter it has been placed on it by sticking tape at its ends.



of the galvanometer is therefore equal to the resistance, reading in the resistance box.

Experiment Readings.

Galvanometer A

S. No.	Original reading of the galvanometer Scale deflection	Final reading of the galvanometer Scale deflection	Resistance of the galvanometer Ohms
1.	20	10	280
2.	18	9	280
3.	10	5	280

Resistance of galvanometer A=280 ohm.

Galvanometer B

S. No.	Original reading of the galvanometer Scale deflection	Final reading of the galvanometer Scale deflection	Resistance of the galvanometer Ohms
1.	20	10	135
2.	18	9	135
3.	16	8	135

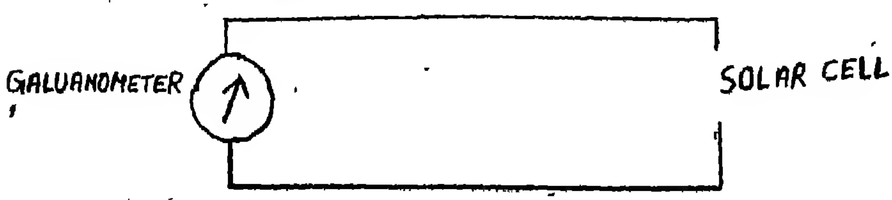
Resistance of galvanometer B=135 ohm.

Galvanometer C

S. No.	Original reading of the galvanometer Scale deflection	Final reading of the galvanometer Scale deflection	Resistance of the galvanometer Ohms
1.	20	10	5
2.	18	9	5
3.	16	8	5

Resistance of galvanometer C=5 ohm.

(2) To find a suitable galvanometer for the experiment



The galvanometers are connected one at a time with the solar cell. The deflection of the galvanometer is noted down and the galvanometer which deflects most is the most sensitive galvanometer. The least sensitive galvanometer is chosen because the intensity of the sun rays is much greater than the intensity of the bulb.

Experimental readings

When the solar cell is held in front of a 60 watt bulb :

Galvanometer	Deflection (Scale Division)
A	8.0
B	9.5
C	0.5

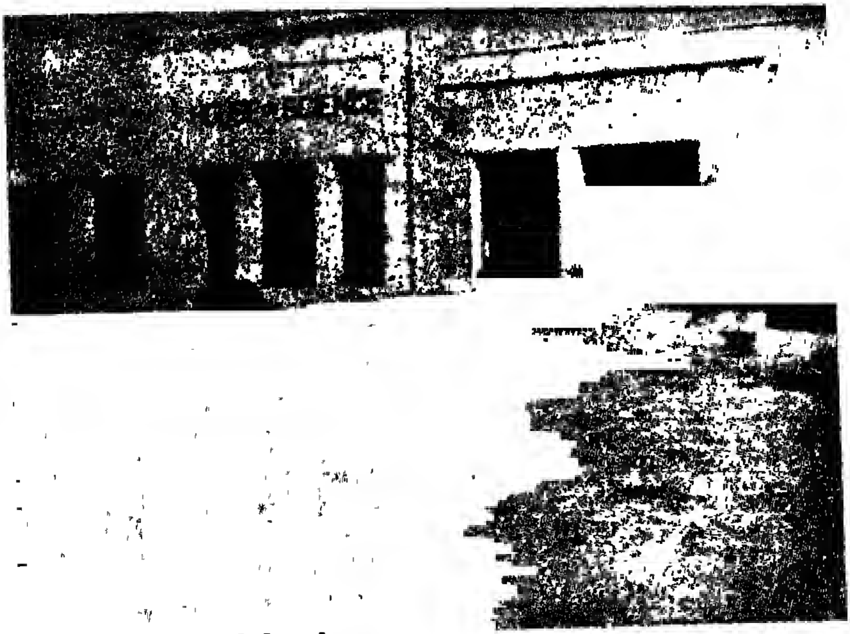
We used galvanometer C whose resistance is 5 Ohms and which deflects 0.5 divisions when the solar cell is held in front of the 60 watt bulb at a distance of 40 cm.

(3) To find the relation between wattage and deflection of the galvanometer.
Electric bulbs of different wattages were used.

A lamp of 15 watts was mounted on an optical bench. The solar cell connected to a galvanometer was mounted at different distances from the bulb. The deflections on the galvanometer were noted. These observations were repeated using 25 watts, 40 watts, 60 watts and 100 watts bulbs.

TABLE 1

S. No.	Lamp	Distance	Deflection			Mean
1.	15 Watts	20 cm	9	8	9	9
		40 cm	7	7	7	7
		60 cm	5	5	5	5
		80 cm	5	5	5	5
		100 cm	5	4	5	5
		120 cm	4	4	4	4
2.	25 Watts	20 cm	12	12	12	12
		40 cm	7	7	7	7
		60 cm	6	6	6	6
		80 cm	5	5	5	5
		100 cm	5	4	4.5	4.
		120 cm	4	4	4	4



Solar cell mounted on a pedastal

Measurement of galvanometer deflection

3.	40 Watts	20 cm 40 cm 60 cm 80 cm 100 cm 120 cm	17 10 7 6 5 4	16 7 5 5 4 4	17 10 7 6 5 4	17 9 7 6 5 4
4.	60 Watts	20 cm 40 cm 60 cm 80 cm 100 cm 120 cm	24 12 8 7 6 4	24 11 8 6 6 4	24 12 8 7 6 4	24 12 8 7 6 4
5.	100 Watts	20 cm 40 cm 60 cm 80 cm 100 cm 120 cm	30 20 12 8 7 5	30 20 12 8 7 5	30 20 12 8 7 5	30 20 12 8 7 5

(2) Choice of light filters

To find the absorption of light by different filters, when mounted in front of an 100 watts lamp at a distance of 50 cm.

(i) The solar cell, connected to a galvanometer, was mounted in front of a 100 watt lamp at a distance of 50 cm. The ground glass filters were placed on the solar cell and the deflections were recorded:

S. No.	Filter	Deflection	Fractional transmission
1.	Without Filter		
	A	12	
	B	7	0.58
	C	9	0.75
	D	8	0.67
	E	8	0.67
	F	9	0.75
	G	8	0.67
	H	7	0.58
	I	7	0.58
	B D	6	0.50
	B D E	4	0.33
	B D E G	2	0.17
	B D E G H	2	0.17
	B D E G H I	2	0.17

(2) The solar cell connected to the galvanometer and directed to diffused (and scattered) light through a window in the laboratory. The deflections were recorded using the ground glass filters.

Filter	Deflection	Fractional Transmission
No filter	23	
D	19.5	0.85
B	18	0.78
B D	12	0.52
B D E	10	0 43
B D E G	7	0.30
B D E G H	6	0.26
B D E G H I	5	0 22

V. Experimental Study

The deflection in the galvanometer, which is proportional to the intensity of the sun rays, was noted at intervals of half an hour.

The experimental arrangement is shown in the photograph.

We connect the galvanometer to the solar cell battery and expose the solar battery to direct sunlight. The shunt is put across the galvanometer and a commutator is included in the circuit. The filter I is put in front of the solar cell and the deflection is noted. Blue, green, yellow and red filters, one at a time are put on the filter I and the deflections are noted. This is repeated after every half hour. The galvanometer with the shunt and commutator are placed in the shade. The solar cell must be completely devoid of light when the experiment is not being performed.

As different shunts have been used, main current was found out before plotting the results :

Experiment Readings

Shunt used =0.5 ohms

Deflection 14th Dec.

	Time	Filter I	Blue	Green	Yellow	Red
	11.00 a.m.	18.5	8.0	7.5	6.5	5.5
cloudy	11.30 a.m.	14.0	5.5	4.5	5.0	4.5
cloudy	12.00 a.m.	14.0	5.0	4.2	4.5	4.0
cloudy	12.30 p.m.	12.2	5.5	5.5	5.0	4.0
	1 05 p.m.	10.5	6.0	5.5	5.0	4.0
	1.30 p.m.	9.0	3.0	2.2	2.5	2.0
	2.00 p.m.	9.0	3.0	2.0	2.1	2.0
	2.30 p.m.	7.0	3.0	2.1	2.0	1.5
	3.00 p.m.	6.5	3.0	2.0	2.0	2.0
	3.20 p.m.	5.0	2.0	1.5	1.0	1.0

Shunt—0.5 ohms

Deflection 15th Dec.

Time	Filter I	Blue	Green	Yellow	Red
11.00 a.m.	15.0	5.5	4.5	4.0	4.0
11.30 a.m.	16.0	[illegible].0	6.0	7.0	6.0
12.00 a.m.	23.5	10.0	8.0	10.0	8.0
12.15 p.m.	30.3	12.0	9.0	11.0	9.0

Shunt used—2 ohms

Deflection 19th Dec.

Time	Filter 1	Blue	Green	Yellow	Red
11.37 a.m.	26.0	10.0	8.0	8.5	7.0
12.00 a.m.	26.0	9.8	7.5	8.5	7.0
12.20 a.m.	27.5	1[illegible].2	8.0	9.0	7.5
1.30 p.m.	24.5	9.0	6.5	7.5	6.0
2.00 p.m.	21.5	7.9	6.0	6.5	5.5
2.30 p.m.	17.0	6.0	4.5	5.0	4.0
3.00 p.m.		4.0	2.8	3.0	2.5

Shunt used—2 ohms

Deflection 21st Dec.

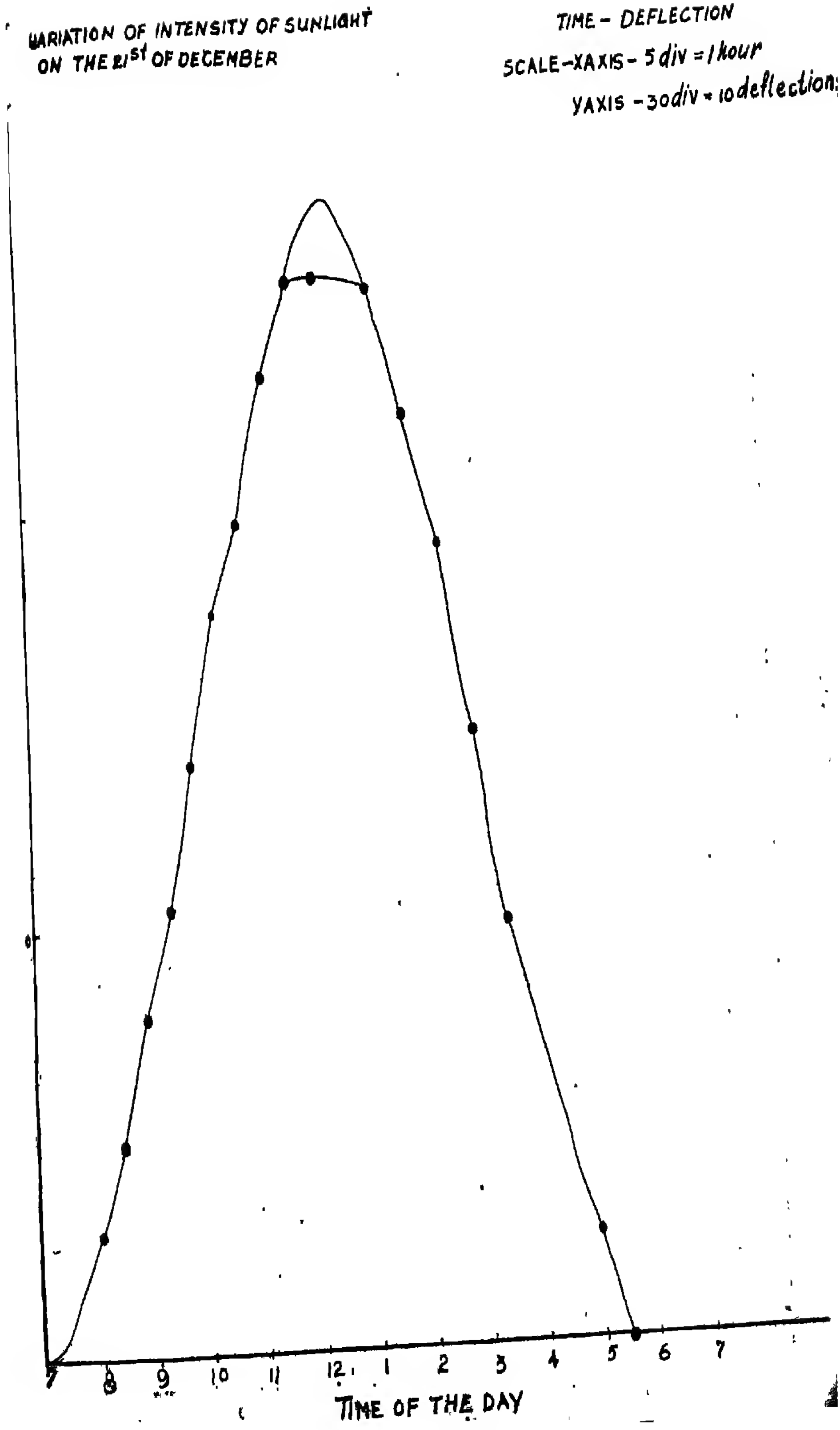
Time	Filter I	Blue	Green	Yellow	Red
8.05 a.m.	3.0	0.7	0.5	0.5	0.3
8.30 a.m.	5.0	1.2	1.0	1.0	0.8
9.00 a.m.	8.0	2.5	1.8	2.0	1.5
9.25 a.m.	10.5	3.5	2.5	3.0	2.5
10.00 a.m.	14.0	5.0	3.5	4.0	3.2
10.30 a.m.	17.5	6.0	4.5	5.0	4.2
11.00 a.m.	19.6	7.0	5.5	6.0	5.2
11.30 a.m.	23.0	8.2	6.0	7.0	5.9
12.00 a.m.	25.2	9.5	6.6	7.5	6.5
12.30 p.m.	25.2	9.2	7.0	7.4	6.4
1.30 p.m.	25.0	9.0	7.0	7.5	6.5
2.00 p.m.	22.0	7.9	6.0	6.5	5.5
2.30 p.m.	19.0	6.9	5.0	5.5	4.5
3.00 p.m.	14.5	5.0	3.5	4.0	3.5
3.30 p.m.	10.0	2.0	2.0	2.5	2.0
5.00 p.m.	2.5	0.8	0.8	0.8	0.5
5.30 p.m.	0.0	0,0	0.0	0.0	0.0

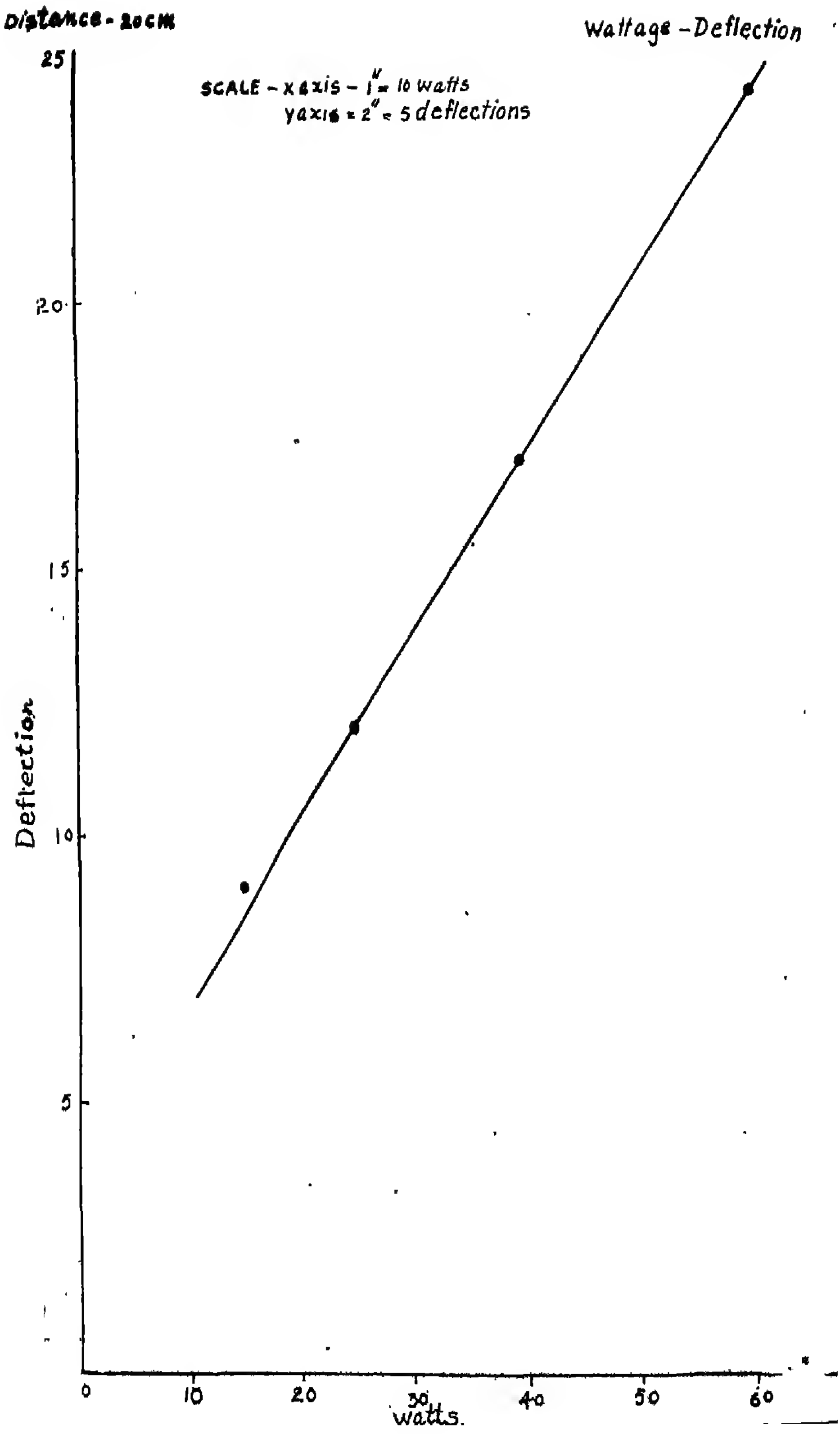
VI Conclusion

The variation of intensity is shown graphically. The maximum intensity was as expected about noon. There is a steady rise in illumination during the morning hours and a steady decline in the afternoon. The diurnal variation is seen in the records but a systematic study was not possible for want of time. More detailed study has to be done in this direction. The absolute measurement of intensity can be done if standard sources of illumination are available. The intensities of the primary colours Blue, Green and Red and the compound colour yellow are according to their wavelengths. It is found that light of shorter wavelengths are more in the total radiation. This result may be due to the selectivity of the soalr cell used.

Acknowledgements

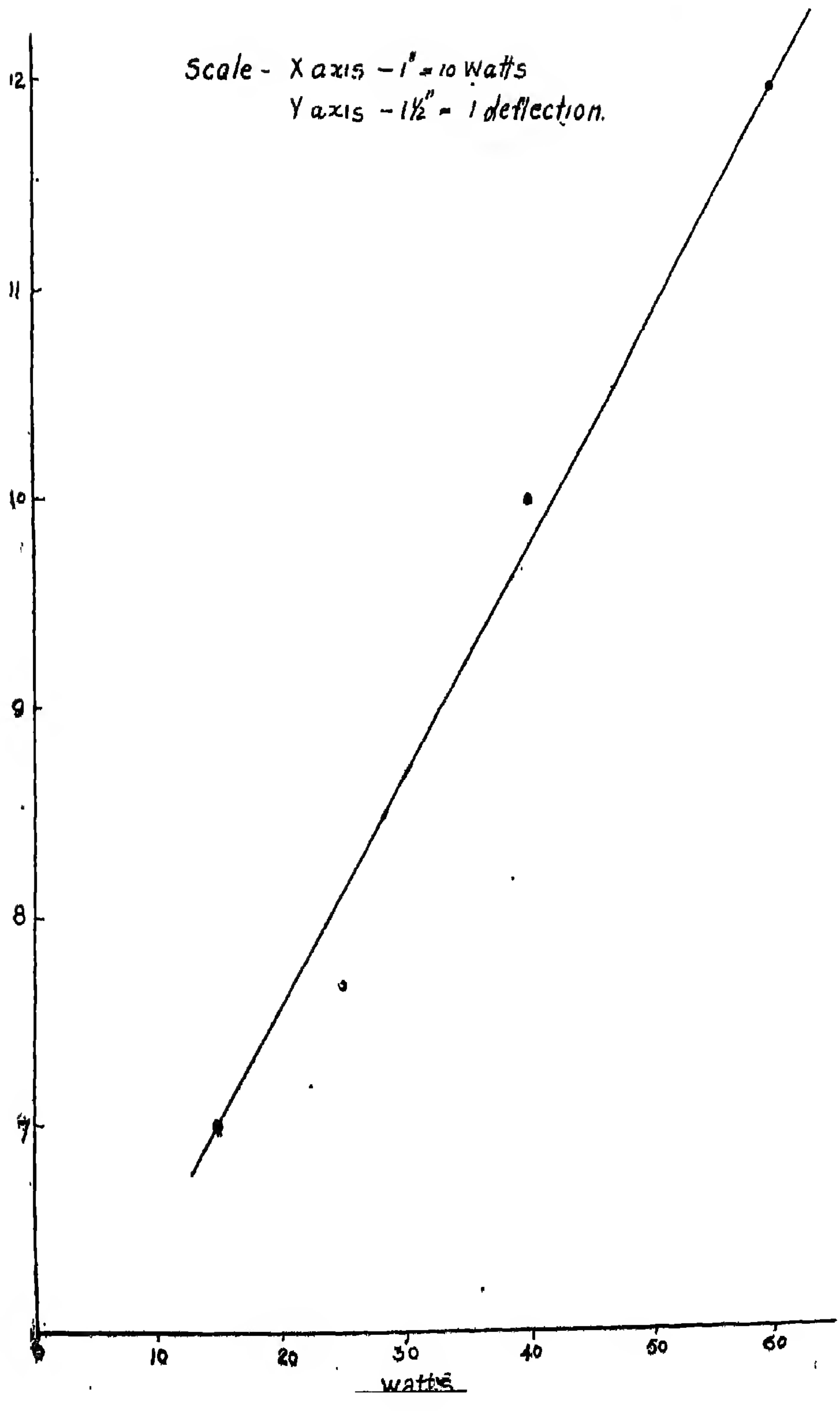
This investigation was made possible through the gift of a solar cell from Dr. B. L. Saraf, Head of the Department of Paysics, University of Rajasthan and I must express my grateful thanks to him. Thanks are also due to my Physics teacher who suggested the problem and guided me throughout. Finally I must express my sincere thanks to the Principal of the School for the provision of the needed apparatus and interest taken.


VARIATION OF INTENSITY OF SUNLIGHT
ON THE 21st OF DECEMBER
TIME - DEFLECTION
SCALE - X AXIS - 5 div = 1 hour
Y AXIS - 30 div = 10 deflection
7
8
9
10
11
12
1
2
3
4
5
6
7
TIME OF THE DAY


Distance - 20CM
Wattage - Deflection
SCALE - x axis - 1" = 10 watts
y axis = 2" = 5 deflections
Deflection
25
20
15
10
5
0
10
20
30
40
50
60
watts.

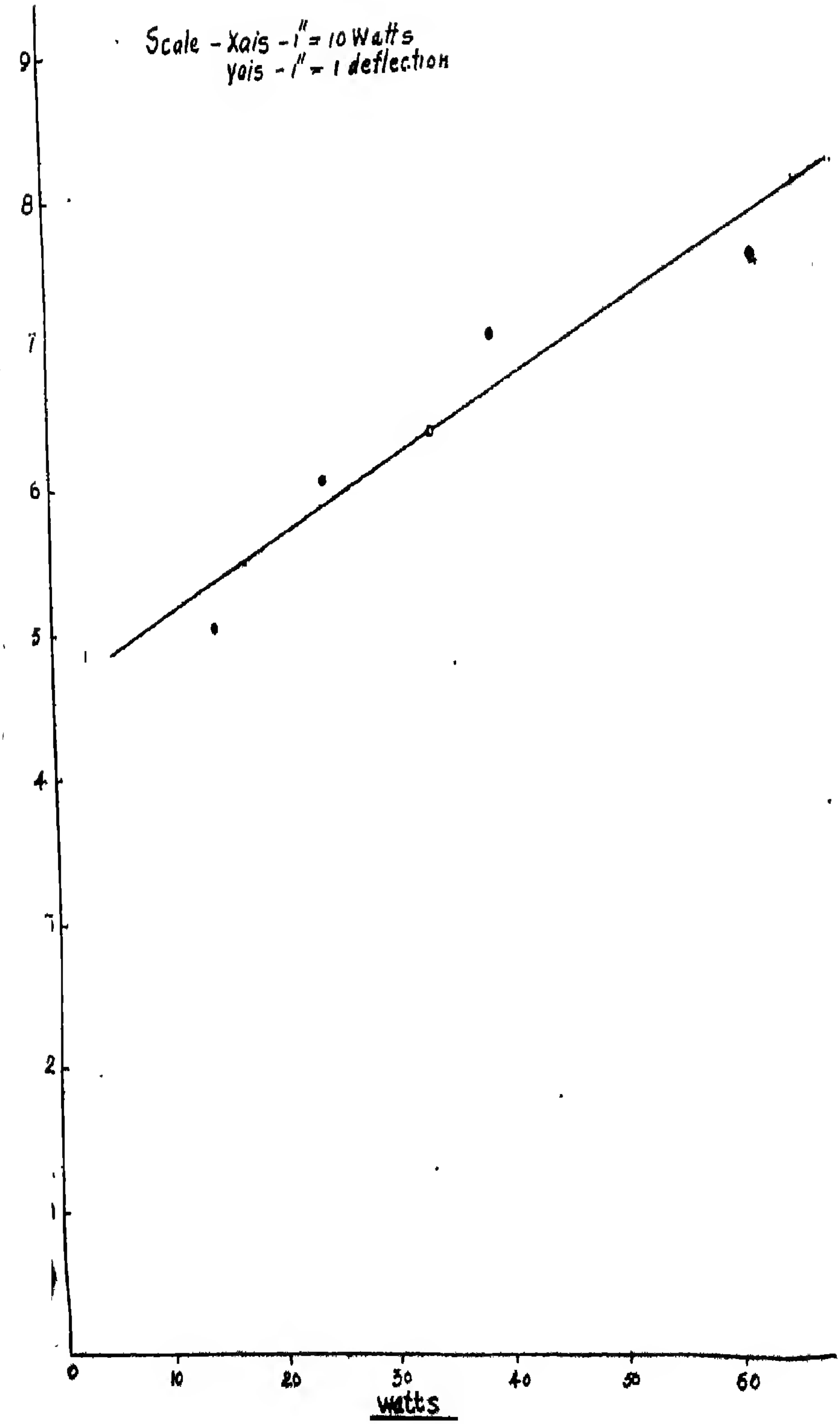
Distance 40cm

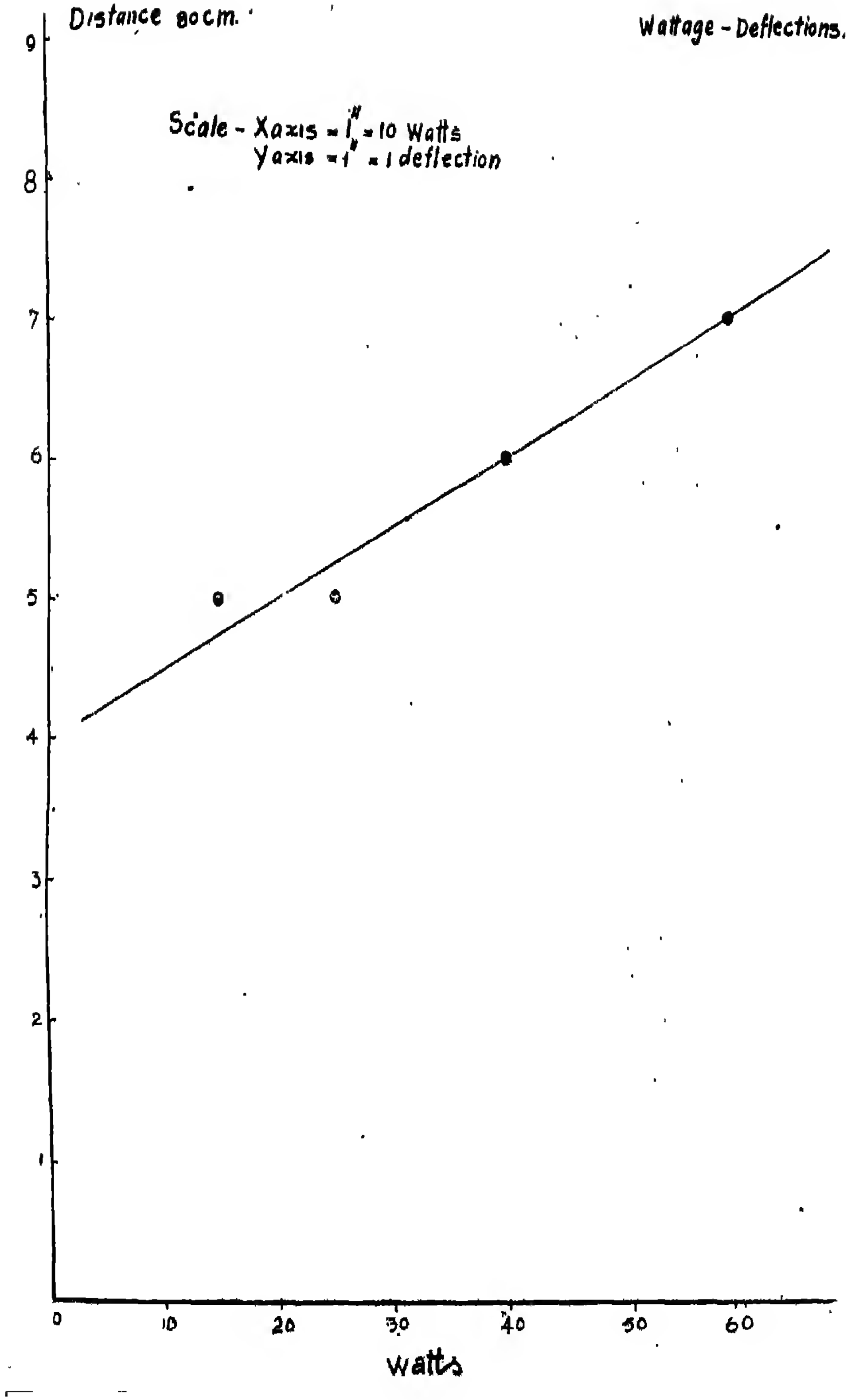
Wattage - Deflection.



Distance - 60 cm

Wattage - Deflection.




Distance 80cm.
Wattage - Deflections.
Scale - X axis = 1" = 10 Watts
Y axis = 1" = 1 deflection
9
8
7
6
5
4
3
2
1
0
10
20
30
40
50
60
Watts

APPEN

AREAWISE ITEMS OF THE

(Quoting actual number of test items

Subject/Test	Physics	Chemistry	*Biology	Mathematics	Agriculture	Geology
PART A						
(Thought Type Items)	1-7 (7)	8-14 (7)	15-23 (9)	24-30 (7)	31-35 (5)	36-40 (5)
PART B						
(I) Factual Type Items	1-30 (30)	1-30 (30)	1-30 (30)	1-30 (30)	X (0)	X (0)
(II) Thought Type Items	31-50 (20)	31-50 (20)	31-50 (20)	31-50 (20)	X (0)	X (0)
Total (Thought Type)	27	27	29	27	5	5
Total (Factual type)	30	30	30	30	X(0)	X(0)
Grand Total	57	57	59	57	5	5

*Biology

	Botany		Zoology
PART A			
Thought Type Items (15-20)	6	(21-23)	3
PART B			
Factual Type Items (1-15) except No. 9	14	(16-30)	16
Thought Type Items (31-41)	11	(42-50)	9
Total	31		28

DIX V

SCIENCE APTITUDE TEST 1967

from the test alongwith the arrangement).

Philosophy of Science	Physiology & Hygiene	Engineering	Meteorology	Biochemistry	Astronomy	Biophysics
41-45 (5)	46-50 (5)	51-55 (5)	56-60 (5)	61-65 (5)	66-70 (5)	71-75 (5)
X(0)	X(0)	X(0)	X(0)	X(0)	X(0)	X(0)
X(0)	X(0)	X(0)	X(0)	X(0)	X(0)	X(0)
5	5	5	5	5	5	5
X(0)	X(0)	X(0)	(X(0)	X(0)	X(0)	X(0)
5	5	5	5	5	5	5

APPENDIX VI

THOUGHT TYPE ITEMS—AN ANALYSIS OF PART (A) OF THE TEST : COMPULSORY

S. No.	Area	Serial of Sections	Number of Passages	Number of Items from each Area	Average number of Items per Passage
	1	2	3	4	5
1.	Physics	1-2	2	4+3 = 7	3.5
2.	Chemistry	3-5	3	5+1+1 = 7	2.3
3.	Botany	6-7	2	4+2 = 6	3.0
4.	Zoology } Biology	8	1	3 = 3 } (9)	3.0 } 3.0
5.	Mathematics	9-10	2	5+2 = 7	3.5
6.	Agriculture	11-14	4	1+1+2+1 = 5	1.25
7.	Geology	15-16	2	3+2 = 5	2.5
8.	Philosophy of Science	17-20	4	1+1+1+2 = 5	1.25
9.	Physiology and Hygiene	21-22	2	3+2 = 5	2.5
10.	Engineering	23-24	2	3+2 = 5	2.5
11.	Meteorology	25-26	2	3+2 = 5	2.5
12.	Bio-Chemistry	27-28	2	2+3 = 5	2.5
13.	Astronomy	29-30	2	2+3 = 5	2.5
14.	Bio-Physics	31-32	2	2+3 = 5	2.5
			32	75	

APPENDIX VI (Contd).

THOUGHT TYPE ITEMS—AN ANALYSIS OF PART (B) OF THE TEST : OPTIONAL

S. No.	Area	Serial of Sections	Number of Passages	Number of Items from each area	Average number of Items per Passage
	1	2	3	4	5
1.	Physics	1-7	7	4+3+2+3+3+3+2=20	2.9
2.	Chemistry	1-8	8	4+2+2+2+2+4+3+1=20	2.5
3.	Mathematics	1-4	4	3+4+10+3–20	5.0
4.	Biology	1-6	6	5+4+2+3+3+3=20	3.3
	(i) Botany	1-3	3	5+4+2=11	3.6
	(ii) Zoology	4-6	3	3+3+3=9	3.0
			25		

APPENDIX (VII)

DEPARTMENT OF SCIENCE EDUCATION
(National Council of Educational Research & Training)

NATIONAL SCIENCE TALENT SEARCH EXAMINATION (1967) MERIT LIST

List of the candidates who have been selected for the award of scholarship and Certificate of merit under the National Science Talent Search Examination, 1967. Their names have been arranged in order of merit.

S. No.	Rank No.	Roll Number	Name of the Candidate	Marks obtained	From where Appeared		Courses Joined
					Centre	State/ Territory	
1	2	3	4	5	6	7	8
1	1	13925	Sh. Amarendra Nath Sinha	199	Purulia	W. B.	Phy.(Hons)
2	2	1094	„ Sandesara Niranjan Bhogilal	197	Ahmedabad	Gujarat	do
3	2	15542	„ Rajen Pratap	197	Delhi	Delhi	Engg.
4	4	12251	„ Kamal Arora	196	Amritsar	Punjab	Phy.(Hons)
5	5	15517	„ Kishan Shenoi	193	Delhi	Delhi	Engg.
6	5	9348	„ K. Muraleedhara Varier	193	Kottayam	Kerala	Phy.(Hons)
7	7	15511	„ Amitabha Basu	192	Delhi	Delhi	do
8	7	16042	„ Rabikar Chatterjee	192	Calcutta	W. B.	Engg.

1	2	3	4	5	6	7	8
9	9	11607	Sh. Ardhendu Sen	191	Delhi	Delhi	Phy.(Hons)
10	10	11223	„ Abhijit Sen	190	Delhi	Delhi	do
11	11	15599	„ Ashoke Kumar Banerjee	187	Calcutta	W.B.	Chem.(Hons)
12	11	16048	„ Amit Mitra	187	Madras	Madras	Engg.
13	13	13687	„ Kumar Srinivas Rao	186	Delhi	Delhi	Phy. (Hons)
14	14	15419	„ Probir Chakraverti	184	„	„	Refused
15	14	11963	Km. Rekha Dev	184	„	„	Zoology (Hons)
16	14	15650	Sh. Padmanabhan Kishore	184	Hazaribagh	Bihar	Phy.(Hons)
17	17	21448	„ Anantnarayan Kumar Subramaniam	183	Calcutta	W.B.	Engg.
18	18	11959	Km. Sangita Suri	182	Delhi	Delhi	Chem.(Hons)
19	18	11637	Sh. M. Ravi Chandran	182	„	„	no reply
20	18	11318	„ S. Kasturirangan	182	„	„	Engg.
21	21	15844	„ D. Raghunandan	181	„	„	do
22	21	13067	„ Bala Krishna Shetty	181	Calcutta	W.B.	Math. (Hons)
23	23	18871	„ Jayant Moreshver Manskar	180	Ambala	Hariyana	B.Sc. (Pass)
24	24	15544	„ Pratha Sarathi Sarkar	179	Delhi	Delhi	Refused
25	24	11224	„ Arun Gupta	179	„	„	Phy.(Hons)
26	24	16072	„ K.V.S. Prasad	179	Bangalore	Mysore	do
27	24	18761	„ James Jesunatha Das	179	Ernakulam	Kerala	Chem.(Hons)
28	24	11239	„ Nag Barindra Nath	179	Calcutta	W.B.	Phy. (Hons)
29	29	15772	„ Dilip Ranganathan	178	Hyderabad	A.P.	do
30	29	21484	„ Burke Darryl Ragnald	178	Calcutta	W.B.	Math. (Hons)
31	31	2514	„ Ashtekar Abhey Vasant Rao	177	Kolhapur	M.S.	Not eligible
32	31	3231	„ Hulikal Ramaiengar Krishnamurthy	177	Bangalore	Mysore	Phy.(Hons)

1	2	3	4	5	6	7	8
33	31	13177	Sh. Sandeep Kumar Sengupta	177	Calcutta	W.B.	Chem. (Hons)
34	34	15963	,, Pulak Datta	176	,,	,,	Phy. (Hons)
35	34	15495	,, Shekhar Priydarshee	176	,,	,,	Engg.
36	34	15663	,, Binay Prasad	176	Patna	Bihar	do
37	34	9627	,, Sudarsana Damodara Prasad	176	Quilon	Kerala	Chem. (Hons)
38	34	18996	,, S. Sridhar	176	Ernakulam	,,	Phy. (Hons)
39	34	4726	,, Deepak Dhar	176	Muzaffar Nagar	U.P.	B.Sc. (Pass)
40	40	15522	,, Bantwal Ramakrishna Rau	174	Delhi	Delhi	Engg.
41	40	11307	,, P. Ramani	174	,,	,,	Underage
42	40	11319	,, A. Koneti Rao	174	,,	,,	no reply
43	40	21483	,, Agarwala Jonathan	174	Calcutta	W.B.	Chem. (Hons)
44	40	21503	,, Abhijit Chatterjee	174	Bankura	,,	do
45	45	26558	,, Chatterji Arun Kumar	173	24 Parganas	,,	Phy. (Hons)
46	45	9694	,, Karthi Keyan Chittayil	173	Trichur	Kerala	do
47	47	13163	,, Kamlesh Kar	171	Calcutta	W.B.	do
48	47	13094	,, Dipan Kar Sarkar	171	,,	,,	do
49	47	22171	,, K.R. Krishna Gandhi	171	Trichur	Kerala	do
50	47	11968	Km. Shobha Madan	171	Delhi	Delhi	do
51	47	6763	Sh. Loveraj Takru	171	Lucknow	U.P.	no reply
52	52	1804	,, Ratna Swamy Chandrashekhar	170	Poona	M.S.	B.Sc. (Pass)
53	52	15423	,, Karuna Shankar Mathur	170	Delhi	Delhi	Engg.
54	52	26560	,, Shankar Kumar Shome	170	24 Pargana	W.B.	Phy. (Hons)
55	52	15964	,, Ashok Mitra	170	Calcutta	,,	Math. (Hons)

1	2	3	4	5	6	7	8
56	52	21498	Sh. Nano Kumar Menon	170	Calcutta	W.B.	M.B.B.S.
57	57	13136	„ Alok Ray	169	„	„	Phy. (Hons)
58	57	15668	Km. Madhuri Guha	169	„	„	do
59	57	6764	Sh. Priyadarshan Roy	169	Lucknow	U.P.	Engg.
60	57	11313	„ V. Sundaresan	169	Delhi	Delhi	B.Sc.
61	57	11970	Km. Madhur Khanna	169	„	„	Botany (Hons)
62	57	15677	Sh. Erach Dorab Tarapore	169	Bombay	M.S.	Engg.
63	57	7886	„ Arun Joseph Thangaraj	169	Chingalput	Madras	Phy. (Hons)
64	64	11278	„ Dinesh Chand Garg	168	Delhi	Delhi	not eligible
65	65	13070	„ Amitava Ray Chaudhuri	167	Calcutta	W.B.	Phy. (Hons)
66	65	15943	„ Raj Kumar Modi	167	Patna	Bihar	Engg.
67	65	21833	„ J. Dinesh Bhat	167	Kozhikode	Kerala	M.B.B.S.
68	65	6341	„ Rajiva Ranjan	167	Gorakhpur	U.P.	B.Sc.
69	65	22250	„ Rajinder Singh Dhillon	167	Chandigarh	U.T.	no-reply
70	70	16938	„ John Varghese	166	Kanpur	U.P.	Phy. (Hons)
71	70	6761	„ Aditya Narayan	166	Lucknow	„	B.Sc.
72	70	13231	Km. Banashree Mandal	166	Calcutta	W.B.	Chem. (Hons)
73	70	8919	Sh. Somanathan K.	166	Trivandrum	Kerala	Phy. (Hons)
74	70	15813	„ K. Sesi Bhushan	166	Delhi	Delhi	no reply
75	70	7170	„ Krishna Ram Rao Bhanavar	166	Madras	Madras	B. Com
76	70	7166	„ K. Sriram	166	„	„	resused
77	77	13145	„ Sreeman Sudipta Kumar Roy	165	Calcutta	W.B.	Phy. (Hons)
78	77	24046	„ Dilip Kumar Shamanna	165	Bangalore	Mysore	B.Sc.
79	77	7996	„ Siddhartha Bhowmick	165	Tiruchirapalli	Madras	Phy. (Hons)

1	2	3	4	5	6	7	8
80	77	18980	Sh. K. Raja Ram	165	Delhi	Delhi	no reply
81	77	15560	,, Haresh M. Shivdasani	165	,,	,,	Engg.
82	82	16044	,, Satyabarata Misra	164	Cuttack	Orissa	B. Sc.
83	82	16037	,, Manish Sarkar	164	Calcutta	W.B.	Chem. (Hons)
84	82	16277	,, Anup Mukerji	164	Patna	Bihar	Phy. (Hons)
85	82	22507	Km. Purnima Pande	164	Nainital	U.P.	refused
86	82	19264	Sh. T. Ranga Rajan	164	Dehradun	,,	Phy. (Hons)
87	82	11972	Km. Madhuri Bihari	164	Delhi	Delhi	Premedical
88	82	12515	,, Lily Dudeja	164	Simla	U.T.	Zoology (Hons)
89	82	16549	Sh. Subramanian Ananthanarayanan	164	Jabalpur	M.P.	B.Sc.
90	90	13090	,, Kumar Dev Bose	163	Calcutta	W.B.	Chem. (Hons)
91	90	12953	Km. Daljit Kaur	163	Hoshiarpur	Punjab	no reply
92	90	11228	Sh. Narendra Dev	163	Delhi	Delhi	Phy. (Hons)
93	90	22869	,, Ashwani Kumar	163	,,	,,	do
94	90	11704	,, Bhaskar Kumar Roy	163	,,	,,	Premedical
95	90	11966	Km. Ranjana Vinayek	163	,,	,,	Phy. (Hons)
96	90	11951	,, Sunita Talwar	163	,,	,,	Botany (Hons)
97	97	21449	Sh. V. Ganesan	162	Calcutta	W.B.	no reply
98	97	16300	Km. Parsathi Sinha	162	,,	,,	Phy. (Hons)
99	97	13147	Sh. Asok Mohan Chakraborty	162	,,	,,	do
100	97	13690	,, Pranab Ranjan Choudhuri	162	24 Parganas	,,	do
101	97	8922	,, Narendra Prasad P.	162	Trivandrum	Kerala	Engg.
102	97	4470	,, Pankaj Joshi	162	Nainital	U.P.	B Sc.
103	97	3943	,, Dinesh Nettar	162	S.Kanara	Mysore	Eligible for next year

1	2	3	4	5	6	7	8
104	97	11343	Km. O.K. Padmini	162	Delhi	Delhi	Phy. (Hons)
105	97	15559	Sh. Amrish Kumar Garg	162	,,	,,	Engg.
106	97	24832	Km. Sadia Din	162	,,	,,	no reply
107	107	22224	Sh. Ayusman Sen	161	Calcutta	W.B.	Chem. (Hons)
108	107	21502	,, Amit Kumar Bose	161	,,	,,	Math. (Hons)
109	107	21500	,, Sanjay Choudhuri	161	Calcutta	,,	Phy. (Hons)
110	107	13071	,, Mohan Kumar Phani	161	,,	,,	do
111	107	14180	Sh. Barindra Dan	161	Dumka	Bihar	do
112	107	6791	,, Syed Faiz Ahmad	161	Lucknow	U.P.	do
113	107	11352	Km. S. Meenakshi	161	Delhi	Delhi	do
114	107	22424	,, Meena Wij	161	,,	,,	Chem. (Hons
115	107	2230	Sh. Alawani Ganesh Madhav	161	Kolhapur	M.S.	B.Sc.
116	116	21447	,, Adarshpal Singh Sethi	160	Calcutta	W.B.	Engg.
117	116	21446	,, Amitava Hazra	160	,,	,,	do
118	116	16301	Km. Jaya Sen	160	,,	,,	Chem. (Hons)
119	116	15940	Sh. Arun Bharathuar	160	Patna	Bihar	M.B B S.
120	116	9762	,, P. Jayanarayanan	160	Trichur	Kerala	Engg.
121	116	9288	,, Ashok M. Menon	160	Ernakulam	,,	Pre-medical
122	116	6762	,, Rajendra Kumar Srivastava	160	Lucknow	U.P.	no reply
123	116	11353	Km. R. Radha	160	Delhi	Delhi	Chem. (Hons)
124	116	11310	Sh. C. R. Rajendran	160	,,	,,	Phy. (Hons)
125	116	18971	Miss K. Sashikala	160	,,	,,	Eligible for next year
126	116	11853	Sh. Nigel Barry Pendse	160	,,	,,	Engg.

1	2	3	4	5	6	7	8
127	116	11965	Km. Vidushi Saraf	160	Delhi	Delhi	Pre-medical
128	116	18306	Sh. K. Ravi Shankar Iyer	160	Chandigarh	Haryana	Engg.
129	116	13074	,, Susanta Sen	160	Calcutta	W.B.	Phy. (Hons)
130	116	13095	,, Soumen Basak	160	,,	,,	do
131	131	13140	,, Anjan Sen	159	,,	,,	Pre-medical
132	131	13926	,, Amlan Kusum Sengupta	159	Purulia	,,	Geology.(Hons)
133	131	13671	,, Soumyendra Nath Maitra	159	Murshedabad	,,	do
134	131	15664	,, Abhijit Sen	159	Patna	Bihar	Engg.
135	131	4574	,, Deepak Kumar Goyal	159	Varanasi	U.P.	do
136	131	11309	,, P. Vasu	159	Delhi	Delhi	Phy.(Hons)
137	131	10663	,, Madhav Vinayak Marathe	159	Bombay	M.S.	B.Sc.
138	131	22249	,, Rakesh Gandhi	159	Chandigarh	Haryana	Engg.
139	139	13873	,, Dhanesh Kumar Sukhani	158	Calcutta	W B.	B Sc.
140	139	13134	,, Swapan Kumar Saha	158	,,	,,	Phy (Hons)
141	139	15666	,, Tapas Sinha	158	Patna	Bihar	do
142	139	9284	,, Thomas, T.	158	Ernakulam	Kerala	Chem.(Hons)
143	139	23209	,, Udayan Madhukar Paranjpye	158	Lucknow	U.P.	B.Sc.
144	139	3437	,, B. Krishnarajulu Naidu	158	Bangalore	Mysore	Phy.(Hons)
145	139	18977	,, Mukesh Bhanti	158	Delhi	Delhi	do
146	139	11622	,, T. Prem Kumar	158	,,	,,	do
147	139	7238	Km. Nandini Nityanada	158	Madras	Madras	Geology(Hons)
148	139	22253	,, Hemant Krishna Singh	158	Chandigarh	Haryana	Engg.
149	139	15927	,, Satiesh Chandra Bhargava	158	Jabalpur	M.P.	do
150	150	11308	,, R. Rangarajan	157	Delhi	Delhi	Chem.(Hons)

1.	2	3	4	5	6	7	8
151	150	11347	Km. K. Usha	157	Delhi	Delhi	No reply
152	150	11280	Sh. Nagesh Sagar	157	,,	,,	do
153	150	15829	,, Ashok Kumar Singh	157	,,	,,	Chem.(Hons)
154	150	11651	,, Rajeev Kumar	157	,,	,,	Phy.(Hons)
155	150	15973	,, Mustansir Barma	157	Bombay	M.S.	Math.(Hons)
156	150	15680	,, Narayanan Chandra Kumar	157	Chingleput	Madras	Chem.(Hons)
157	150	1457	,, Trivedi Ajay Indukant	157	Ahmedabad	Gujarat	Engg
158	150	22252	,, Sukhbir Singh	157	Chandigarh	U.T.	do
159	150	22251	,, Bhupinder Singh	157	,,	,,	B Sc.
160	160	21497	,, Banerji Lakhindar	156	Calcutta	W.B,	Math.(Hons)
161	160	13491	Km. Bandana Chatterjee	156	Howrah	,,	Chem (Hons)
162	160	9490	Sh. Kuruvilla Eapen	156	Kottayam	Kerala	Phy.(Hons)
163	160	3151	Km Chitra Venkataraman	156	Bangalore	Mysore	do
164	160	11305	Sh. K. S. Anand	156	Delhi	Delhi	do
165	160	15525	,, Sunder M. Kekre	156	,,	,,	Engg.
166	160	15520	,, Pradeep Narain Bansod	156	,,	,,	do
167	160	11930	,, Tanganath Desikan	156	,,	,,	Phy.(Hons)
168	160	11955	Km. Ritu Suri	156	,,	,,	B.Sc.
169	160	11954	,, Kusum Guglani	156	,,	,,	Pre-medicai
170	160	5987	Sh. V. Sankara Sastry	156	,,	,,	B.Sc.
171	160	2641	,, Velamur Varadan Anand	156	Nagpur	M.S.	Phy.(Hons)
172	172	13137	,, Swapan Chattopadhyay	155	Calcutta	W.B.	do
173	172	26559	,, Pradip Choudhuri	155	24 Pargana	,,	Chem.(Hons)
174	172	16038	,, Syed Siraul Hasan	155	Lucknow	U.P.	Phy.(Hons)

1	2	3	4	5	6	7	8
175	172	11383	Sh. Rakesh Jha	155	Delhi	Delhi	No reply
176	172	11302	,, R. Ramachandran	155	,,	,,	Phy.(Hons)
177	172	11199	,, Kawal Jeet Singh Sethi	155	,,	,,	B.Sc.
178	172	11809	,, Aiyagari Sudhakar Rao	155	,,	,,	do
179	172	12086	Km. Amita Malik	155	,,	,,	No reply
180	172	22248	Sh. Trilochan Singh Anand	155	Chandigarh	U.T.	Engg.
181	181	4571	,, Anil Kumar Singh	154	Dehradun	U.P.	B Sc.
182	181	4662	,, Rajiv Kumar Gupta	154	Lucknow	,,	Engg.
183	181	4659	,, Rajiv Sen	154	,,	,,	do
184	181	3940	,, Narendra Nayak	154	S. Kanara	Mysore	Chem (Hons)
185	181	11829	,, Amit Kumar Ganguli	154	Delhi	Delhi	Phy (Hons)
186	181	11612	,, Bappaditya Chakravarty	154	,,	,,	do
187	181	7162	,, K. Sajeeva Thomas	154	Madras	Madras	Eligible for Next Year
188	181	16280	,, Vijay Vir Singh Virk	154	Karnal	Haryana	B.Sc.
189	181	26561	,, Gitesh Ranjan Bhattacharjee	154	24 Pargana	W.B,	Zoology (Hons)
190	190	10077	,, Surendran K. K.	153	Trichur	Kerala	Phy (Hons)
191	190	9279	,, P. Mohana Krishnan	153	Ernakulam	,,	do
192	190	11350	Km. J. Shashi Kala	153	Delhi	Delhi	No reply
193	190	22868	Sh. Sushil Rattan Khanna	153	,,	,,	Pre-medical
194	190	18979	,, Surendra Ponrathnam	153	,,	,,	Chem.(Hons)
195	190	11608	,, Alok Bhattacharya	153	,,	,,	do
196	190	11969	Km. Usha Kaushik	153	,,	,,	No reply
197	190	18820	Sh. Asutosh Mathur	153	Bombay	M.S.	B.Sc.

1	2	3	4	5	6	7	8
198	190	8609	Sh. Sidharatha Purkayartha	153	Tripura	U.T.	Phy.(Hons)
199	190	1455	Km. Bhambri Manju Mohanlal	153	Ahmedabad	Gujarat	do
200	200	12089	,, Sobha Nambisan	152	Delhi	Delhi	Chem.(Hons)
201	200	15827	Sh. Shekhar Chauduhri	152	Delhi	Delhi	No reply
202	200	11231	,, Raj Kumar Jolly	152	Delhi	Delhi	Pre-medical
203	200	13874	,, Rattan Krishan Sukhani	152	Delhi	Delhi	Phy.(Hons)
204	200	13164	,, Subit Kumar Mandal	152	Calcutta	W.B.	Phy.(Hons)
205	200	3584	,, Eswarahalli Sundararajan Dattatreya	152	Bangalore	Mysore	B.Sc.
206	200	7120	,, Sreenivasan Murlidharan	152	Chingleput	Madras	Phy.(Hons)
207	200	4581	,, Paramjit Singh Sidhu	152	Dehradun	U.P.	do
208	200	8671	,, Adhikari Mayum Surjalal Sharma	152	Manipur	U.T.	do
209	200	4579	,, Shailendra Sahai	152	Dehradun	U.P.	Engg.
210	200	15769	,, B. Ashok	152	Hyderabad	A.P.	do
211	211	18303	,, Ajit Singh Hira	151	Chandigarh	Haryana	B.Sc.
212	211	15713	,, Vinod Wadhi	151	Ranchi	Bihar	No reply
213	211	22425	Km. Dolly Choudhry	151	Delhi	Delhi	Phy.(Hons)
214	211	11956	,, Neera Bhalla	151	Delhi	Delhi	Batany (Hons)
215	211	18990	Sh. Narendra Singh Yadav	151	Delhi	Delhi	do
216	216	12066	Km. Usha Gupta	150	Delhi	Delhi	Phy.(Hons)
217	216	11650	Sh. Varun Kumar Prasad	150	Delhi	Delhi	No reply
218	216	11827	Km. Sheela Roy	150	Delhi	Delhi	Phy.(Hons)
219	216	11855	Sh. Ramachandran Sreenivasa	150	Delhi	Delhi	underage
220	216	11320	,, C. R. Rajan	150	Delhi	Delhi	Phy.(Hons)

1	2	3	4	5	6	7	8
221	216	11438	,, Rajiv Krishan	150	Delhi	Delhi	Chem.(Hons)
222	216	15727	,, E. A. Chakachery	150	Midnapore	W.B.	Math.(Hons)
223	216	13575	,, Prithwish Dutt	150	Burdwan	W.B.	Engg.
224	216	13698	,, Debashis Chakraberty	150	24-Parganas	W.B.	Chem.(Hons)
225	216	13249	Miss Rita Das	150	Calcutta	W.B.	do
226	216	15464	Sh. Krishna Kumar	150	Secunderabad	A.P.	No reply
227	216	3155	Km. Ragini Vedantan	150	Bangalore	Mysore	B.Sc.
228	216	16091	Sh. Mohan Menon	150	Bangalore	Mysore	Engg.
229	216	10508	Miss Vijaya Laxman Deshpande	150	Sholapur	M.S.	B.Sc.
230	216	4658	Sh. Navin Hiranand Makhijani	150	Bombay	M.S.	Engg.
231	216	5261	,, Sudhir Kumar Saxena	150	Bareilly	U.P.	B.Sc.
232	232	15649	,, Ranjit Kumar Nair	149	Hazaribagh	Bihar	No. reply
233	232	8883	,, Kose John	149	Trivandrum	Karela	Phy.(Hons)
234	232	21829	,, Arungundram Krishna Murthi Vijaya Kumar	149	Madras	Madras	Math. (Hons)
235	232	12254	,, Raj Kumar	149	Amritsar	Punjab	Phy.(Hons)
236	232	5511	,, Om Prakash Gupta	149	Kanpur	U.P.	B.Sc.
237	232	4582	,, Ashok Arora	149	Dehradun	U.P.	B.Sc.
238	232	15139	,, Salit Banerji	149	Midnapore	W.B.	Phy.(Hons)
239	232	13705	,, Swapan Kumar Bose	149	24-Pargana	W.B.	Chem.(Hons)
240	232	13174	,, Pranab Roy	149	Calcutta	W.B.	do
241	232	15497	,, Prabhat Narayan Shukla	149	Calcutta	W.B.	Engg.
242	232	22206	,, Apji Suchet Chaudhuri	149	Calcutta	W.B.	Chem (Hons)
243	232	11953	Km. Sushil Duggal	149	Delhi	Delhi	Phy.(Hons)

1	2	3	4	5	6	7	8
244	232	12011	Km. Krishna Mazumdar	149	Delhi	Delhi	Phy.(Hons.)
245	232	11359	Sh. Pravin Kumar	149	Delhi	Delhi	Engg.
246	246	15509	,, Amar Kumar	148	Delhi	Delhi	No reply
247	246	15823	,, Manoj Shukla	148	Delhi	Delhi	Geology(Hons)
248	246	11311	,, N. Arjun	148	Delhi	Delhi	Math.(Hons)
249	246	13897	,, Swapan Kumar Chatterjee	148	Nadia	W.B.	Chem.(Hons)
250	246	13930	,, Asim Ranjan Pati	148	Purulia	W.B.	Phy.(Hons)
251	246	13564	,, Ranjit Chatterjee	148	Burdwan	West Bengal	Chem.(Hons)
252	246	15647	,, Raj Bhuptani	148	Hazaribagh	Bihar	Engg.
253	246	15766	,, Ashfaq H. Arastu	148	Hyderabad	A.P.	Refused
254	246	9135	,, Neithalath Mohan Kumar	148	Palghat	Karela	Math.(Hons)
255	246	15676	,, C.P. Mammoy	148	Quilon	Kerala	Refused
256	246	6728	,, Raman Srivastava	148	Lucknow	U.P.	B.Sc.
257	246	16085	,, R. Ravindran	148	Bangalore	Mysore	No reply
258	246	10312	,, Wahiduddin Ahmad	148	Jorhat	Assam	Phy (Hons)
259	246	12792	,, Dinesh Kumar	148	Ambala	Haryana	B.Sc.
260	246	21835	,, V. Kumaraswami	148	Madras	Madras	do
261	261	15141	,, Deva Prasad Saha	147	Midnapore	West Bengal	Phy.(Hons)
262	261	22176	,, P. P. Sreedharan Namboodri	147	Trichur	Keral	Math.(Hons)
263	261	6732	,, Rakesh Jindal	147	Lucknow	U.P.	B.Sc.
264	261	18969	,, Arun Kumar Grover	147	Meerut	U.P.	B.Sc.
265	261	18305	,, Anil Banerji	147	Chandigarh	U.T.	B.Sc.
266	261	1934	,, Neelamegam Sundarajan	147	Bombay	M.S.	B.Sc.
267	261	2820	Km. Roshen Onden	147	Bombay	M.S.	B.Sc.

1	2	3	4	5	6	7	8
268	261	22433	Km. Vaishna Jaggi	147	Delhi	Delhi	Pre-Medical
269	261	12209	,, Renu Taparia	147	Delhi	Delhi	do
270	261	11960	,, Sumitra Basu	147	Delhi	Delhi	M.B.B.S.
271	261	11962	,, Usha Sharma	147	Delhi	Delhi	Pre-Medical
272	261	12076	,, Bina Agarwal	147	Delhi	Delhi	Engg.
273	261	11337	,, R. Latha	147	Delhi	Delhi	Pre-Medical
274	274	9375	Sh. Jitendra Nath Budhraja	146	,,	,,	Phy.(Hons.)
275	274	15418	,, Anil Chaterji	146	,,	,,	Math.(Hons)
276	274	15451	,, Arindam Sen	146	,,	,,	Phy (Hons)
277	274	11507	Km. Geeta Kiron Bhalla	146	,,	,,	B.Sc.
278	274	12075	,, Poonam Nanda	146	,,	,,	Botany(Hons)
279	274	12083	,, Shobha Ranjan	146	,,	,,	Chem. (Hons)
280	274	11619	Sh. Chanchalendu Banerjee	146	,,	,,	Engg.
281	274	11881	,, Ashok Mehandru	146	,,	,,	do
282	274	11348	Km. V. G. Geetha	146	,,	,,	Zoology (Hons.)
283	274	2642	Sh. Arindam Banerjee	146	Nagpur	M.S.	B.Sc.
284	274	3240	,, Seshadri M. Prasad	146	Bangalore	Mysore	do
285	285	4573	,, Ashok Benegal	146	Dehradun	U.P.	Engg.
286	274	20753	Km. Meenakshi Avasthi	146	,,	,,	Phy. (Hons)
287	274	8993	Sh. T. K. Prakash	146	Ernakulam	Kerala	no reply
288	274	9691	Km. Ananda Valley L.	146	Trichur	,,	Phy. (Hons)
289	274	15665	Sh. Manoranjan Prasad	146	Patna	Bihar	do
290	274	13522	,, Asok Kumar Sen	146	Bankura	W.B.	Engg.
291	274	15966	Sh. Ranabrata Sen	146	Calcutta	W.B.	Phy. (Hons)

1	2	3	4	5	6	7	8
292	274	21485	Sh. Gadre Deepak	146	Calcutta	W.B.	B.Sc.
293	274	13693	,, Ashok Kumar Chowdhury	146	24-Pargana	,,	Phy. (Hons)
294	294	13786	Sh. Monoj Kumar Dutta	145	Hooghly	,,	Chem. (Hons.)
295	294	13171	,, Utpal Sanyal	145	Calcutta	,,	,,
296	294	13253	Miss Parbati Bhattacharya	145	,,	,,	Phy.(Hons)
297	294	22210	Sh. Prithish Ganguly	145	,,	,,	Engg.
298	294	10176	,, Tamirisa Venkata Srinivasa Charyulu	145	Tanuku	A.P.	Pre-Med.
299	294	23238	Km. Kum Kum Kanwar	145	Lucknow	U.P.	B.Sc.
300	294	7866	Sh. R. Ramani	145	Chingleput	Madras	Engg.
301	294	1966	,, Shaikh Rashid Ahmed Mohamed Usman	145	Bombay	M.S.	B.Sc.
302	294	9377	,, Shyam Kumar Gupta	145	Delhi	Delhi	Phy.(Hons)
303	294	12187	,, Arvind Mangla	145	,,	,,	do
304	294	12064	Km. Santosh Kumari	145	,,	,,	do
305	294	11730	Sh. Ravindar Khanna	145	,,	,,	Engg.
306	294	11303	,, V. Sridhar	145	,,	,,	Phy. (Hons)
307	307	12019	Km. Nirmal Kaur	144	,,	,,	M.B.B.S.
308	307	12088	,, Sandhya Misra	144	,,	,,	Chem.(Hons)
309	307	11854	,, Vindu Mittal	144	,,	,,	Phy.(Hons)
310	307	11323	Sh. M. Seshadri	144	,,	,,	B.Sc.
311	307	11346	Miss K.K. Lalitha	144	,,	,,	Phy.(Hons)
312	307	3076	Sh. Vivek Vishwanath Rane	144	Belgaum	Mysore	B.Sc.
313	307	3566	,, Hampapuram Kasturi Krishna Priyan	144	Bangalore	,,	Math.(Hons)

1	2	3	4	5	6	7	8
314	307	15950	Sh. Santosh Kumar Rao	144	Kanpur	U.P.	Math.(Hons.)
315	307	9580	Km. Sobhini S.	144	Palaghat	Kerala	Chem.(Hons)
316	307	16191	Sh. Master Biswajit Banerjee	144	Hazaribagh	Bihar	Engg.
317	307	15143	,, Chitra Durga Narasimha Murthy	144	Midnapore	W.B.	Engg.
318	307	13709	,, Anjan Kumar Das	144	24-Parganas	W.B.	Phy. (Hons)
319	307	13069	,, Soumya Chakravarti	144	Calcutta	,,	do
320	307	15598	,, Santanu Dutta	144	Calcutta	,,	Engg.
321	307	2576	,, Vijay Kumar Dattatraya Rao Toley	144	Nagpur	M.S.	B.Sc.
322	307	16056	Km. Nandini Katre	144	Bombay	M.S.	do
323	307	7203	Sh. P.N. Vijay (Pattamadai Nataraja Sarma)	144	Madras	Madrat	Phy. (Hons)
324.	307	18809	,, R. Jaya Mohan Pillai	144	Chingalput	Madras	Zoology (Hons)
325	307	15911	Km. Rupa Sirohi	144	Jaipur	Rajasthan	B.Sc.
326	307	4466	Sh. Inder Jit Singh	144	Indore	M.P.	no reply
327	327	15667	,, Kamaduj Sharan	143	Patna	Bihar	Engg.
328	327	6943	,, Narayanaswami Sathyamoorthy	143	Cuddalore	Madras	Chem.(Hons)
329	327	15917	,, Shri Om Prakash Panwar	143	Karnal	Haryana	B.Sc.
330	327	4584	,, Ramesh Sampath	143	Lucknow	U.P.	Engg.
331	327	4575	,, Deepak Batia	143	Dehradun	U.P.	B.Sc.
332	327	16290	Km. Pradeep Kaur	143	Simla	H.P.	B.Sc.
333	327	2042	Sh. Bevis Angelo Coutinho	143	Bombay	M.S.	Math.(Hons)
334	327	2245	,, Kothari Surajmal Chandmal	143	Poona	M.S.	B Sc.
335	327	15641	,, Swoyam Prakash Rout	143	Cuttak	Orissa	B.Sc.
336	327	13072	,, Sugata Ray	143	Calcutta	W.B.	Chem.(Hons)

1	2	3	4	5	6	7	8
337	327	13149	Sh. Arun Prasad Chatterjee	143	Calcutta	W.B.	Phy. (Hons)
338	327	13176	,, Alokenath Bhattacharyya	143	Calcutta	W.B.	Math.(Hons)
339	327	11638	,, S. Rangarajan	143	Delhi	Delhi	no reply
340	327	22870	,, Akhilesh Bansal	143	Delhi	Delhi	Engg.
341	327	11344	Miss R. Shantha	143	Delhi	Delhi	Math.(Hons)
342	327	11364	Sh. Yudhisthir Kumar	143	,,	,,	Phy.(Hons)
343	327	11495	Miss Jaishree Benerjee	143	,,	,,	Chem.(Hons)
344	327	8895	Sh. Sabir M.	143	Trivandrum	Kerala	Phy.(Hons)
345	327	9458	,, Jese P. Panakkal	143	Trichur	,,	do
346	346	19691	Sh. Om Parkash Sharma	142	Delhi	Delhi	do
347	346	11506	Km. Gavinder Kaur Mujral	142	,,	,,	M.B.B.S.
348	346	11508	,, Madhu Agarwal	142	,,	,,	Phy.(Hons)
349	346	16334	Sh. Rakesh Bhalla	142	,,	,,	B.Sc.
350	346	18994	,, Thimiri Perumal Rajmanohar	142	,,	,,	Engg.
351	346	11322	,, N. Ramesh	142	,,	,,	Phy.(Hons)
352	346	11349	Km. V. Mahalakshmi	142	,,	,,	Botany(Hons)
353	346	10177	Sh. Meduri Venkata Bhaskara Satyanarayana Murthy	142	Tanuku	A.P.	B.Sc.
354	346	20198	Sh. S. Jayaraman	142	Ranchi	Bihar	do
355	346	1459	,, Falgnni Kumar Sen	142	Ahmedabad	Gujarat	Phy. (Hons)
356	346	9822	,, Thadathil Mathews George	142	Alleyppey	Kerala	Chem.(Hons)
357	346	23966	,, George Cyriae	142	,,	,,	no reply
358	346	15686	,, Ralph Victor D'rozario	142	Kozhikode	,,	do

1	2	3	4	5	6	7	8
359	346	16371	Sh. Arunabha Datta	142	Shilong	Assam	Chem.(Hons)
360	346	7657	Km. Kursheed Begum Fqkkir Mohamed	142	Madurai	Madras	Math. (Hons)
361	346	20747	,, K. Shankar Rani	142	Dehradun	U.P.	B.Sc.
362	346	2766	Sh. Dixit Ajit Suresh Lal	142	Bombay	M.S.	Inter science
363	346	2649	Km. Neela Madhukar Kher	142	Nagpur	M.S.	B.Sc.
364	346	2933	,, Satuinder Dhillan	142	Nagpur	M.S.	B.Sc.
365	346	13898	Sh. Hrishi Kesh Das	142	Nadia	W.B.	Phy. (Hons)
366	346	13232	Km. Anjana Basak	142	Calcutta	W.B.	Chem.(Hons)
367	116	1451	,, Iyengar Usha Parthasarathy	160	Madras	Madras	B.Sc.
368	97	1803	,, Ravthi Kalyana Sundaram	162	M.S.	M.S.	do

APPENDIX VIII

ANALYSIS OF THE MERIT LIST, TAKING SLABS OF 50 RANKS IN SIX GROUPS (IN ORDER OF MERIT) TO INDICATE THE EDUCATIONAL COURSES OPTED BY THE AWARDEES (LAST GROUP IS OF 68)

		RANK BANDS							
S. No.	Courses opted	1-50	51-100	101-150	151-200	201-250	25ˈ-300	301-368	Total	% age
1.	B.Sc. (i) Physics (Hons)	22	17	15	15	15	10	18	112	30.5
	(ii) Chemistry (Hons)	7	3	6	8	7	4	8	43	11.7
	(iii) Math. (Hons)	2	1	1	2	3	3	6	18	4.9
	(iv) Botany (Hons)	...	2	...	...	...	1	1	4	1.0
	(v) Zoology (Hons)	1	1	...	1	2	1	1	7	1.9
	(vi) Geology (Hons)	...	...	3	...	1	...	—	4	1.0
	(vii) B.Sc. (General)	2	7	5	8	7	13	20	62	16.8
	Total	34	31	30	34	35	32	54	250	68.0
		1-50	51-100	101-150	151-200	201-250	251-300	301-368	Total	% age
2.	Premedical	...	2	3	2	1	5	...	13	3.5
3.	Engineering & Technology	10	5	12	7	7	8	8	57	15.5
4.	Underage	1	0	0	0	1	0	0	2	0.5
5.	No reply	2	6	2	6	6	2	4	28	7.6
6.	Refused	2	2	0	0	0	2	0	6	1.6
7.	Joining Next year	...	...	2	1	0	0	0	3	0.8
8.	Not eligible	1	1	0	0	0	0	2	2	0.5
9.	Professional courses	...	2	1	0	0	1	...	6	1.6
10.	B.Com	...	1	...	...	...	...	...	1	0.2
	Total	50	50	50	50	50	50	68	368	

APPENDIX IX A (II)

YEAR WISE AND STATEWISE PERCENTAGE DISTRIBUTION OF THE AWARDEES

S.No.	State/Territory	Year 1994	Year 1965	Year 1966	Year 1967
1.	A.P.	0.85	1.23	0.6	1.63
2.	Assam	2.26	2.15	0.3	0.54
3.	Bihar	1.13	4.00	0.85	4.07
4.	Delhi	29.38	29.85	41.8	33.69
5.	Gujarat	2.00	—	1.50	1.35
6.	Haryana	—	—	—	3.53
7.	J & K	No candidate appeared	—	—	—
8.	Kerala	-do-	0.31	3.65	7.33
9.	Madras	3.95	4.00	1.50	4.34
10.	M.P.	7.62	0.62	4.8	0.81
11.	M.S.	10.45	11.08	8.50	5.97
12.	Mysore	3.11	7.08	4.50	3.80
13.	Orissa	2.00	1.85	1.2	0.54
14.	Punjab	11.02	3.38	2.25	0.81
15.	Rajasthan	1.13	1.54	1.50	0.27
16.	U.P.	13.81	8.31	9.5	8.69
17.	U.T. (Except Delhi)	1.13	0.9	0.3	1.08
18.	W.B.	10.17	23.69	17.0	21.46

APPENDIX IX B

LANGUAGE-WISE DISTRIBUTION OF CANDIDATES WHO APPEARED AND A STATE-WISE STATEMENT OF THE AVERAGE SCORE SCORED BY THE EXAMINEES AT THE ESSAY PAPER 1967

S. No.	State	English	Hindi	Punjabi	Gujarati	Marathi	Kannada
1.	Andhra Pradesh	136	...	...	...	...	...
2.	Assam	19	...	...	...	...	...
3.	Bihar	48	144	...	...	...	...
4.	Delhi	804	48	...	...	1	...
5.	Gujarat	22	1	...	51	2	...
6.	Jammu & Kashmir	17	5	2	...	...	...
7.	Kerala	349	...	...	...	...	...
8.	Madhya Pradesh	80	458	...	...	1	...
9.	Madras	239	1	...	...	...	...
10.	Maharashtra	172	15	...	4	231	6
11.	Mysore	355	1	...	...	5	118
12.	Orissa	47	...	...	...	...	...
13.	Punjab	60	24	27	...	...	...
14.	Rajasthan	36	193	...	...	...	...
15.	Uttar Pradesh	213	707	...	...	...	...
16.	West Bengal	208	8	...	...	...	...
17.	Union Territories Except Delhi	39	23	...	...	5	...
18.	Haryana	78	64	3	...	...	...
19.	Total	2922	1692	32	55	245	124
20.	% age	48.30	27.90	0.51	0.81	4.05	2.50
21.	Average Marks Scored	20.83	18.79	21.29	17.05	20.21	17.63

APPENDIX IX B (Contd.)

LANGUAGE-WISE DISTRIBUTION OF CANDIDATES WHO APPEARED AND A STATE-WISE STATEMENT OF THE AVERAGE SCORE SCORED BY THE EXAMINEES AT THE ESSAY PAPER 1967

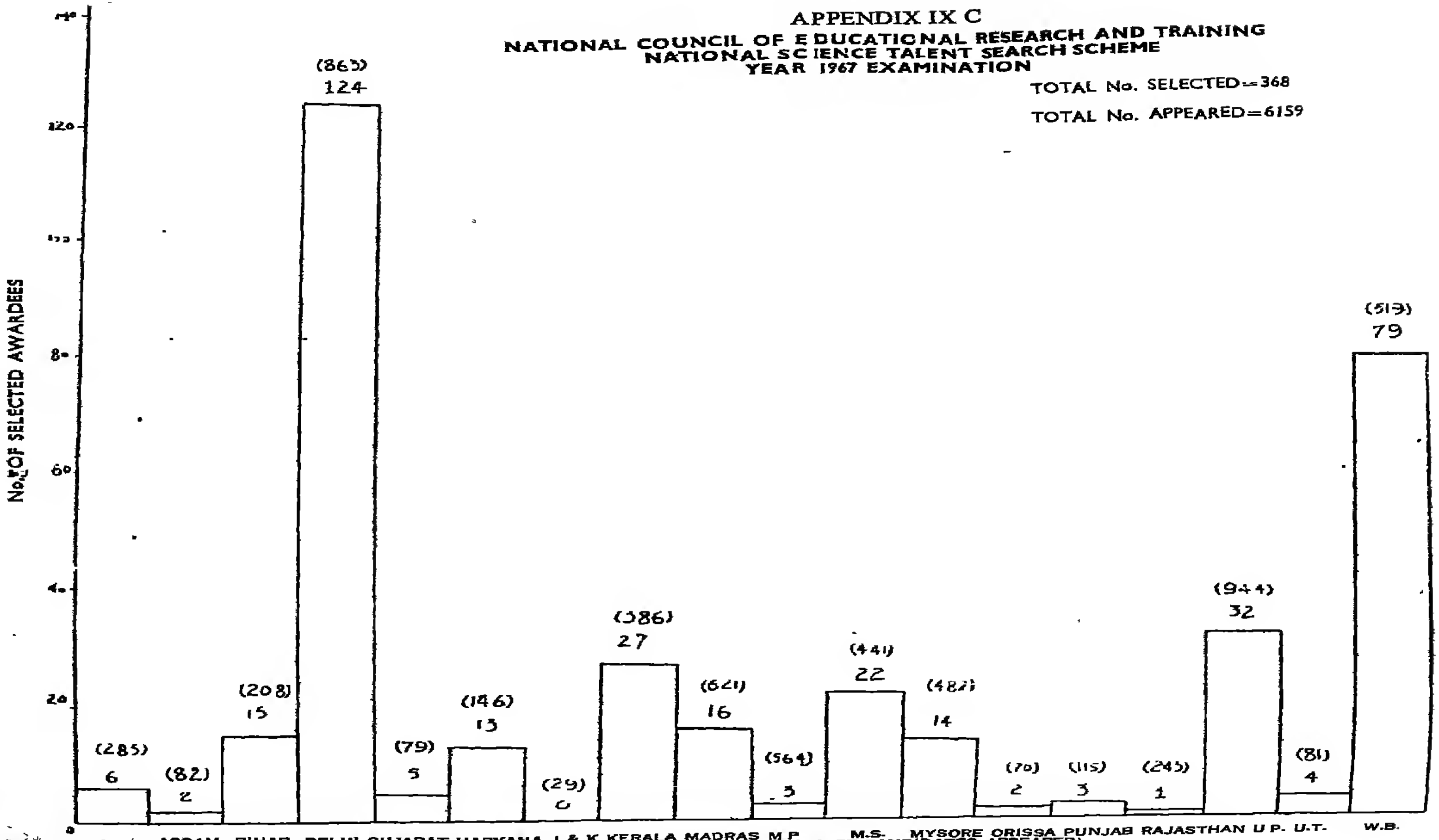
Urdu	Bengali	Malayalam	Assamese	Tamil	Telugu	Orlya	Total	Average score
5	...	...	...	...	136	1	278	16.35
...	11	...	51	...	...	...	81	23.60
...	12	...	...	...	...	1	205	21.63
...	1	...	...	...	...	...	854	22.70
...	...	...	...	...	...	...	76	16.80
5	...	...	...	...	...	...	29	18.00
...	...	33	...	2	...	...	384	22.75
3	...	...	...	...	...	...	542	16.20
1	...	1	...	376	1	...	619	21.20
4	...	...	...	...	...	...	432	20.28
...	...	...	...	1	...	...	480	17.50
...	...	...	...	...	...	22	69	21.10
...	...	...	...	...	...	...	111	21.45
...	...	...	...	...	...	...	229	18.00
2	...	...	...	...	...	...	922	19.30
...	297	...	...	...	...	...	513	22.30
...	13	...	...	...	...	...	80	21.50
...	...	...	...	..	...	...	145	22.10
20	334	34	51	379	137	24	6049	
0.32	5.52	0.52	0.80	6.26	6.26	0.35		
18.06	22.29	22.70	23.60	21.20	16.38	20.92		

APPENDIX IX C

NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING
NATIONAL SCIENCE TALENT SEARCH SCHEME
YEAR 1967 EXAMINATION

TOTAL No. SELECTED=368

TOTAL No. APPEARED=6159



(FIGURES IN THE BRACKETS INDICATE THE NUBMBER OF CANDIDATES APPEARED)

STATE-WISE DISTRIBUTION OF AWARDEES SELECTED IN THE N.S.T.S. EXAMINATION YEAR 1967

APPENDIX (X A)

MEASURES OF CENTRAL TENDENCY AND VARIABILITY OF SCORES INTERVIEW—BOARD WISE (ZONAL)

Centres / Tests	Delhi Mean	Delhi Sd.	Calcutta Mean	Calcutta Sd.	Bangalore Mean	Bangalore Sd.	Bombay Mean	Bombay Sd.	Dehradun Mean	Dehradun Sd.	Total Mean	Total Sd.
Sc. Aptitude Test	80.12	13.58	79.69	13.92	74.5	12.25	74.5	12.37	77.69	11.51	77.5	13.46
S.E.	0.797	0.563	0.870	0.615	0.747	0.528	0.990	0.700	0.893	0.631	0.399	0.282
Skewness	0.388		0.473		0.396		0.125		0.303		0.394	
Essay	26.26	5.81	27.39	6.495	27.08	7.41	27.42	6.53	26.98	6.26	26.98	6.63
S.E.	0.341	0.241	0.406	0.287	0.452	0.319	0152	0.370	0.486	0.343	0.196	0.138
Skewness	0.721		0.177		0.378		0.383		0.057		0.225	
Project	13.91	4.10	12.27	4.83	12.22	3.97	13.87	4.73	13.25	4.49	13.04	4.46
S.E.	0.241	0.170	0.302	0.213	0.242	0.171	0 379	0.268	0.348	0.246	0.132	0.093
Skewness	0.164		0.339		0.116		0.117		0.275		0.217	
Interview	17.32	7.92	21.75	7.78	15.57	11.16	18.55	9.22	23.06	5.77	19.62	9.60
S.E.	0.474	0.335	0.497	0.351	0.701	0.495	0.821	0.580	0.469	0.331	0.295	0.209
Skewness	1.250		- 0.659		0 724		0.625		0.278		0.356	

Table No. (II)

Frequency Distribution of Scores on Essay Paper

(Interview Boardwise)

Class Interval	Delhi	Dehradun	Bangalore	Bombay	Calcutta	Total
5-9	7	—	3	1	1	12
10-14	3	4	14	7	5	33
15-19	18	18	21	5	23	85
20-24	61	30	42	26	51	210
25-29	124	64	85	46	82	401
30-34	66	33	55	42	56	252
35-39	9	14	41	23	34	121
40-44	1	2	8	5	4	20
45-49	1	1	—	1	—	3
Total	290	166	269	156	256	1137
Mean	26.26	26.98	27.08	27.42	27.39	26.98
S.D.	5.818	6.266	7.411	6.529	6.495	6.634

APPENDIX (X B)

Table No. 1

Frequency Distribution of Scores on Science Aptitude Test (Interview Board wise)

Class Interval	Delhi	Dehradun	Bangalore	Bombay	Calcutta	Total
40-49	2	—	2	2	—	6
50-59	8	6	20	13	10	57
60-69	53	34	81	47	53	268
70-79	88	61	81	40	82	352
80-89	76	37	54	38	48	253
90-99	35	22	23	12	37	129
100-109	20	6	7	4	20	57
110-119	8	—	1	—	6	15
Total	290	166	269	156	256	1137
Mean	80.12	77.69	74.50	74.50	79.69	77.50
S.D.	13.587	11.514	12.255	12.377	13.918	13.466

Table No. (ii)

Frequency Distribution of Scores on Essay Paper

(Interview Boardwise)

Class Interval	Delhi	Dehradun	Bangalore	Bombay	Calcutta	Total
5-9	7	—	3	1	1	12
10-14	3	4	14	7	5	33
15-19	18	18	21	5	23	85
20-24	61	30	42	26	51	210
25-29	124	64	85	46	82	401
30-34	66	33	55	42	56	252
35-39	9	14	41	23	34	121
40-44	1	2	8	5	4	20
45-49	1	1	—	1	—	3
Total	290	166	269	156	256	1137
Mean	26.26	26.98	27.38	27.42	27.39	26.98
S.D.	5.818	6.266	7.411	6.529	6.495	6.634

Table No. (III)

Frequency Distribution of Scores on Project Report
(Interview Boardwise)

Class Interval	Delhi	Dehradun	Bangalore	Bombay	Calcutta	Total
1-2	—	3	3	2	10	18
3-4	1	2	5	2	11	21
5-6	14	8	11	4	11	48
7-8	15	14	29	10	20	88
9-10	33	15	37	22	42	149
11-12	40	19	61	24	29	173
13-14	48	43	45	24	36	196
15-16	62	24	35	20	45	186
17-18	37	16	30	14	35	132
19-20	27	14	11	21	8	81
21-22	11	7	1	11	9	39
23-24	2	1	1	2	—	6
Total	290	166	269	156	256	1137
Mean	13.91	13.25	12.22	13.87	12.27	13.04
S.D.	4.107	4.498	3.977	4.733	4.829	4.462

Table No. (iv)

Frequency Distribution of Scores on Interview
(Interview Boardwise)

Class Interval	Delhi	Dehradun	Bangalore	Bombay	Calcutta	Total
0-4	—	—	43	—	—	43
5-9	22	—	49	24	5	100
10-14	111	1	46	23	36	217
15-19	64	8	32	30	67	201
20-24	38	27	27	19	56	167
25-29	18	61	26	11	48	164
30-34	10	36	9	9	13	77
35-39	12	13	12	8	13	58
40-44	3	4	7	2	6	22
45-49	1	1	2	—	1	5
Total	279	151	253	126	245	1054
Mean	17.32	28.06	15.57	18.55	21.75	19.62
S.D.	7.924	5.772	11.156	9.225	7.781	9.604

Graphical Representations

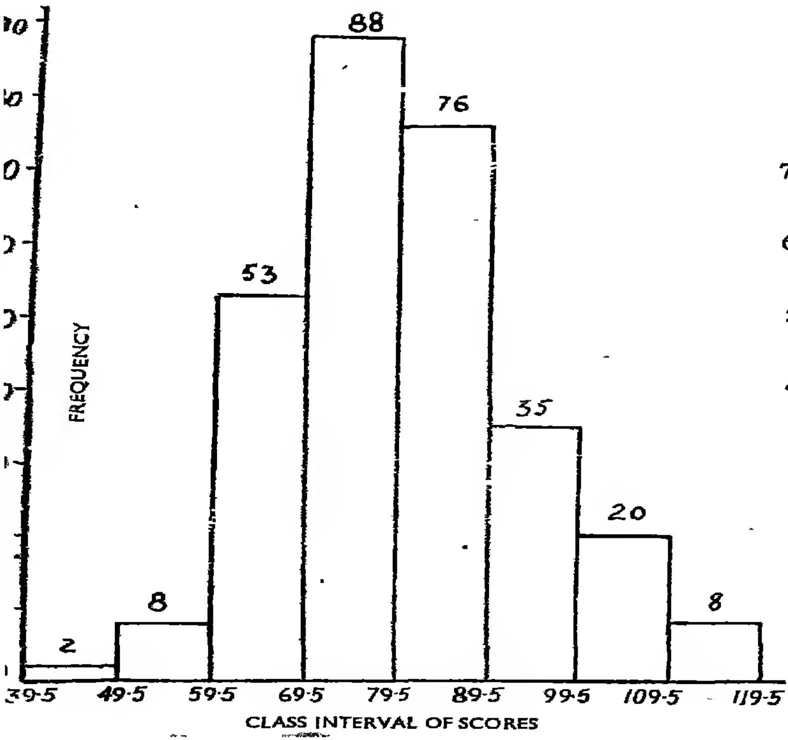
APPENDIX XB (Contd.)

FREQUENCY DISTRIBUTION OF SCORES ON SCIENCE APTITUDE TEST BOARDWISE

DELHI BOARD

TABLE B(I) 1

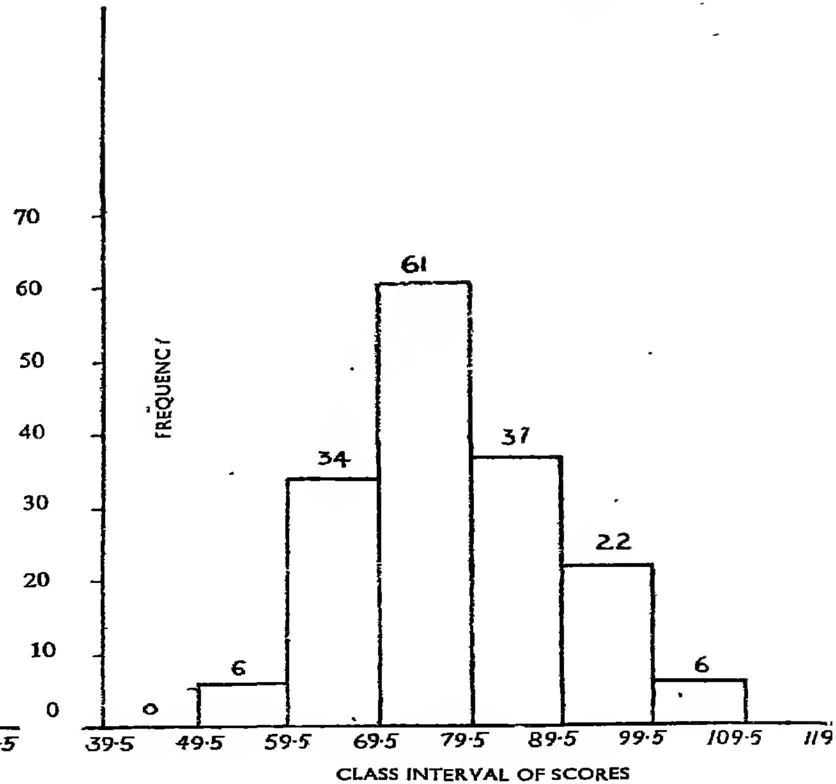
N=290



DEHRADUN BOARD

TABLE B(I) 2

N=166



Graphical Representations

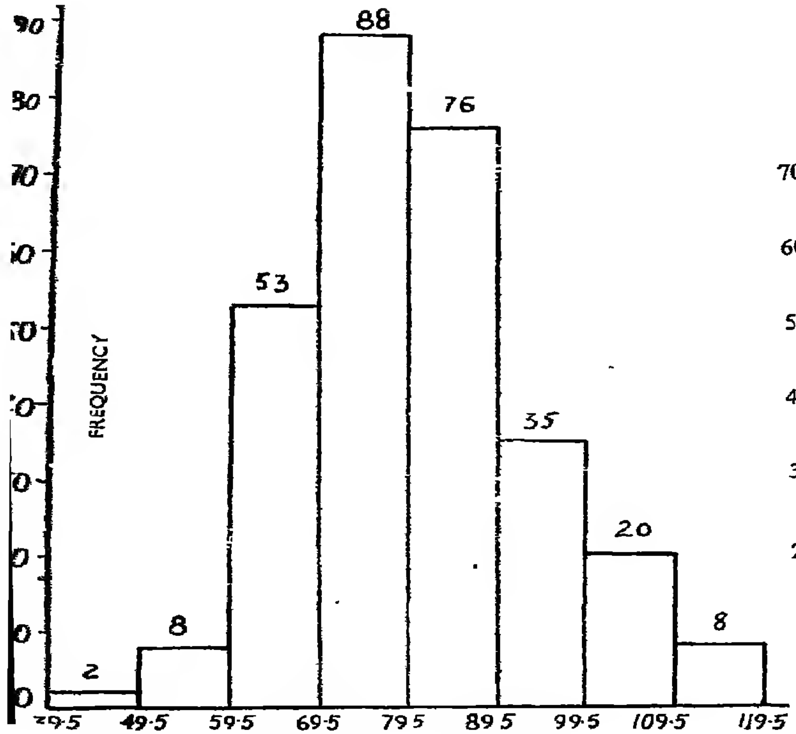
APPENDIX XB (Contd.)

FREQUENCY DISTRIBUTION OF SCORES ON SCIENCE APTITUDE TEST BOARDWISE

DELHI BOARD

TABLE B(I) 1

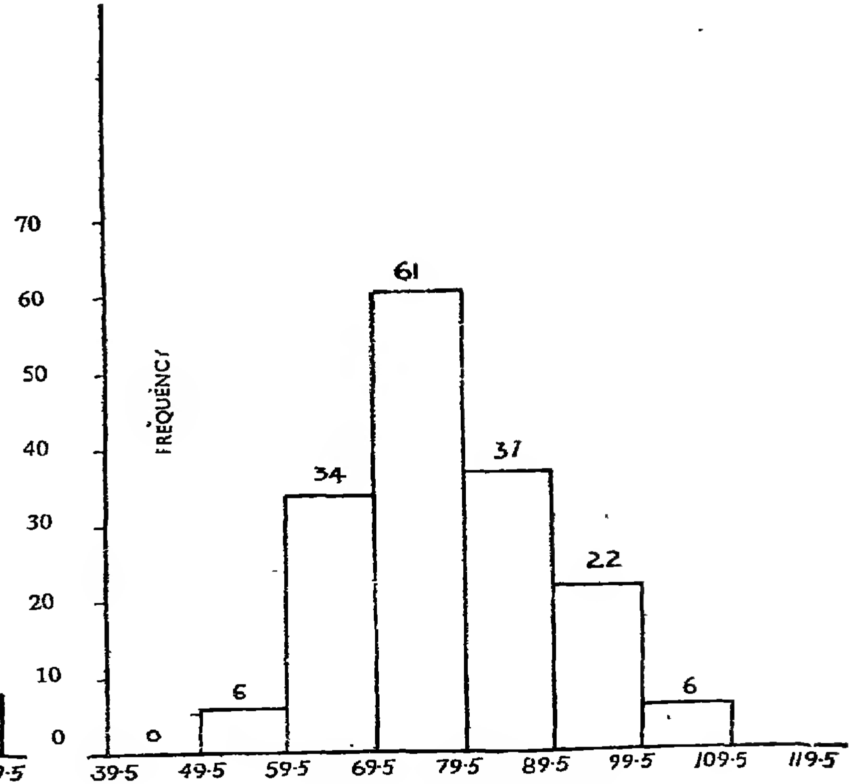
N=290



DEHRADUN BOARD

TABLE B(I) 2

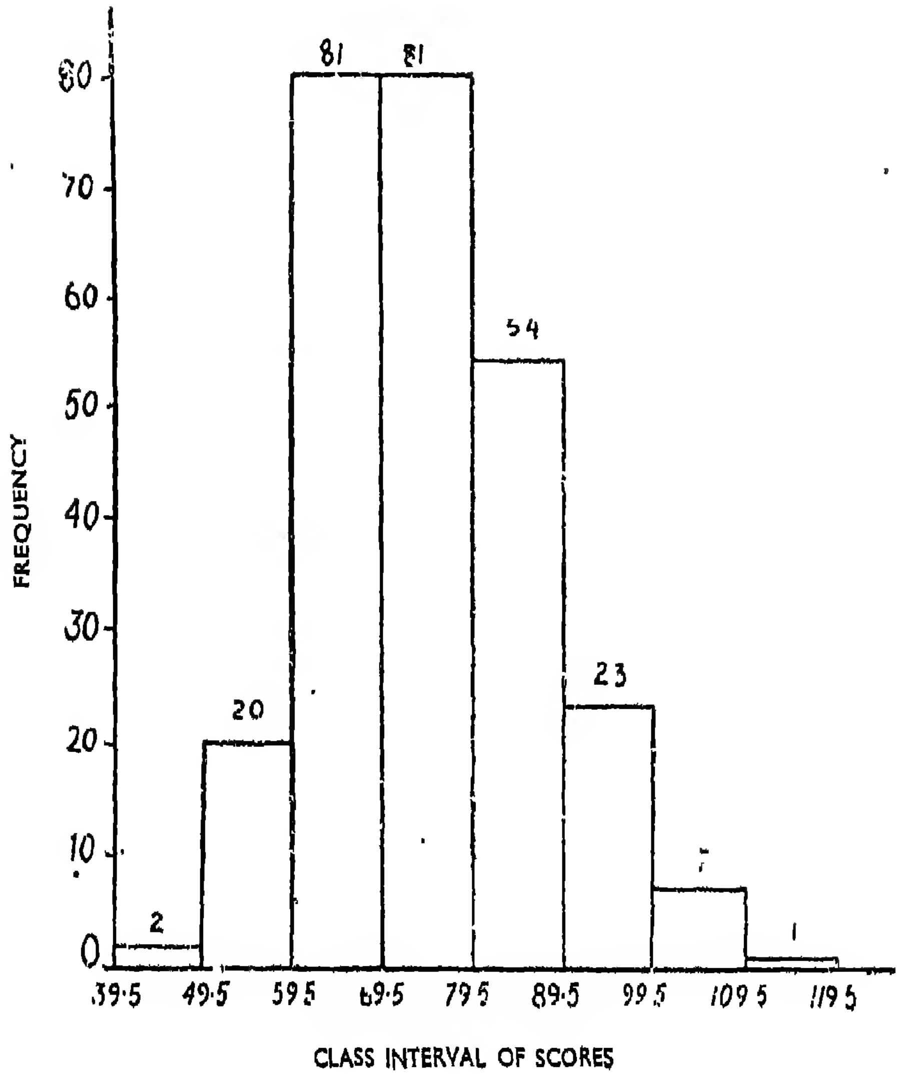
N=166



BANGALORE BOARD

N=269

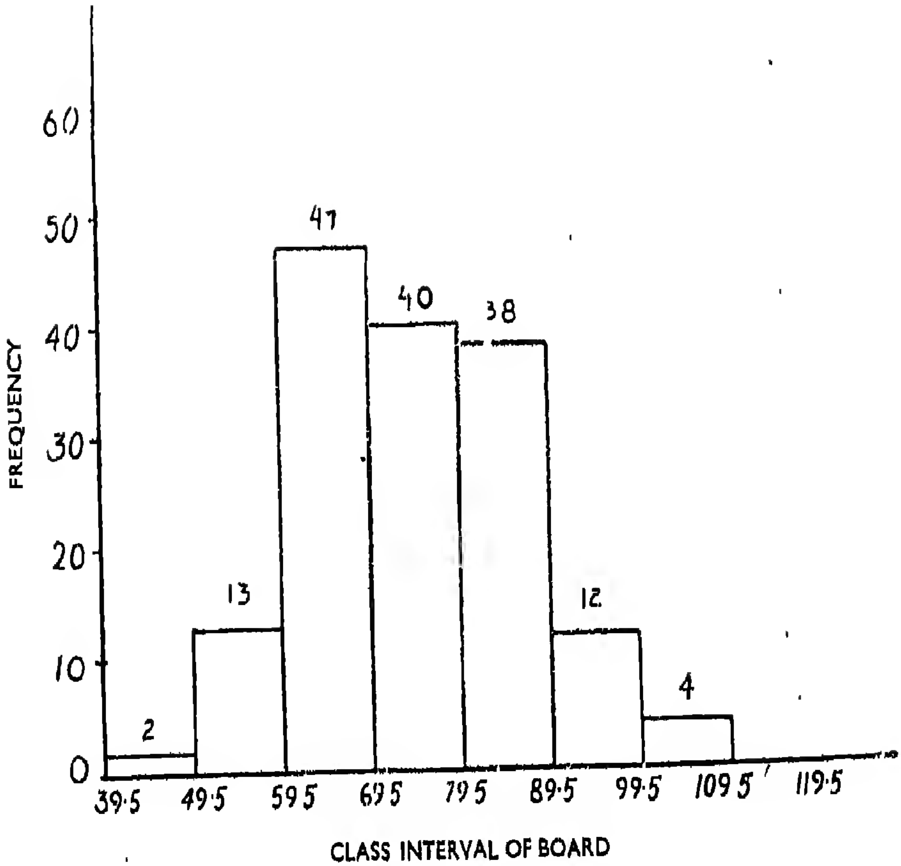
TABLE B(I)-3



BOMBAY BOARD

TABLE B(I)-4

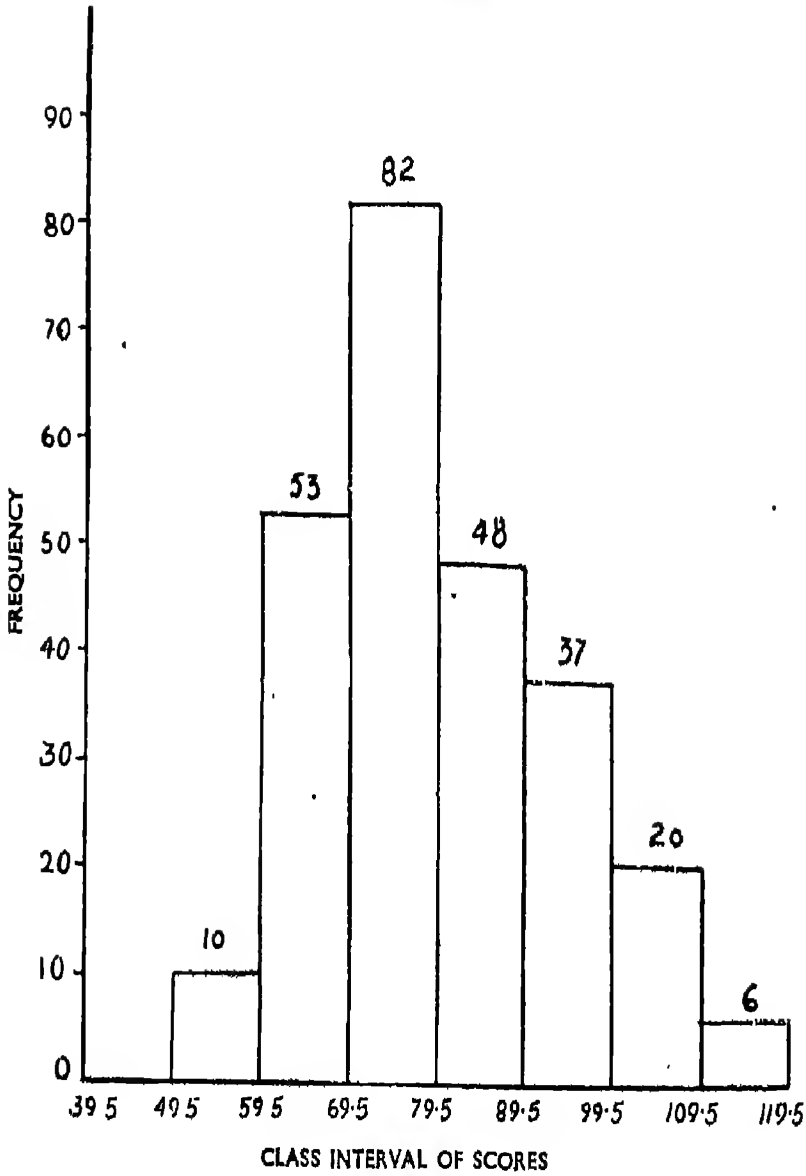
N=156



CALCUTTA BOARD

N=256

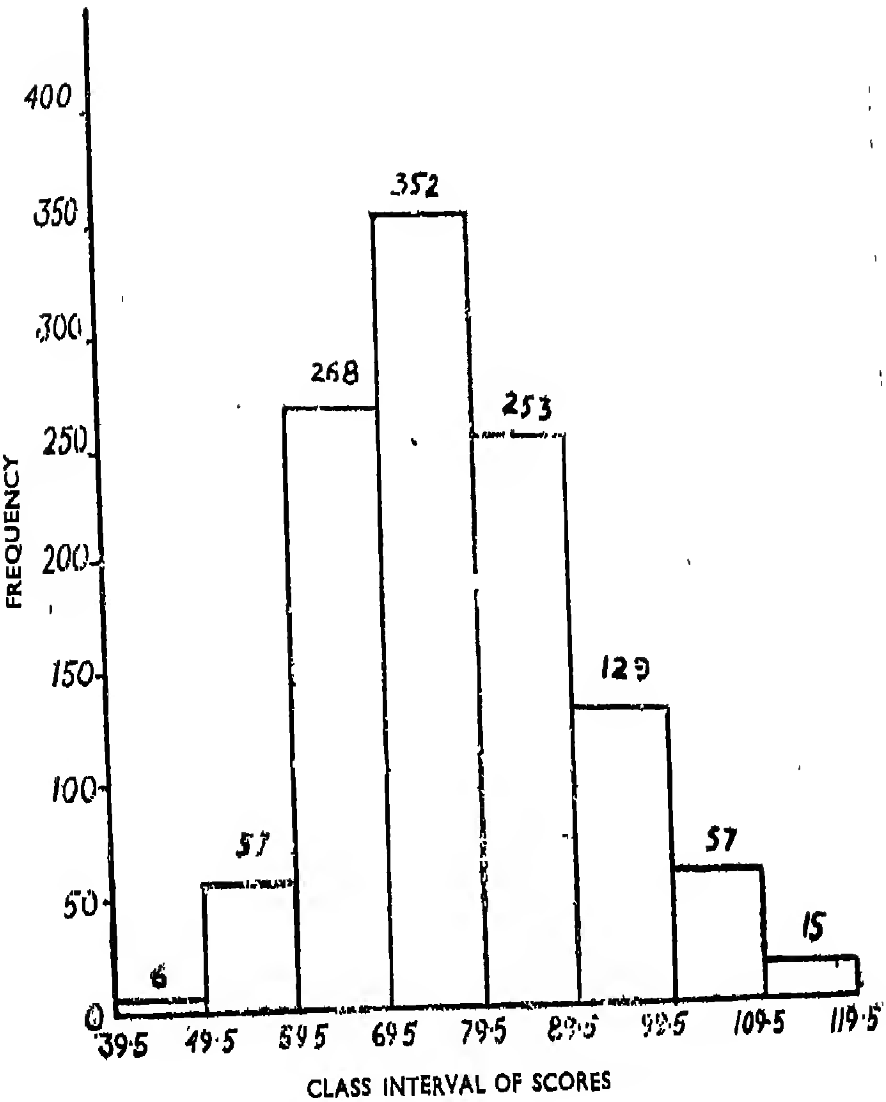
TABLE B(I)-5



GRAND TOTAL

TABLE B(I)-6

N=1137

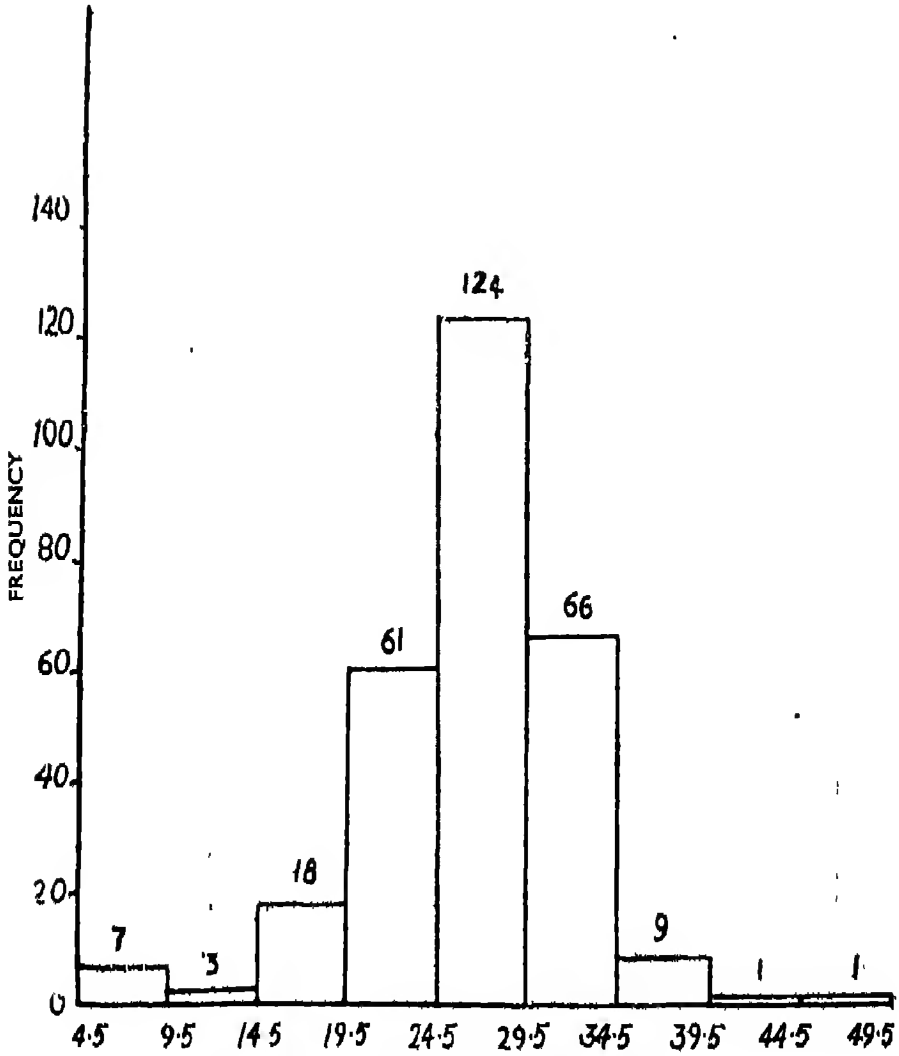


FREQUENCY DISTRIBUTION OF SCORES ON ESSAY PAPER (INTERVIEW BOARDWISE)

DELHI BOARD

TABLE B(ii)-I

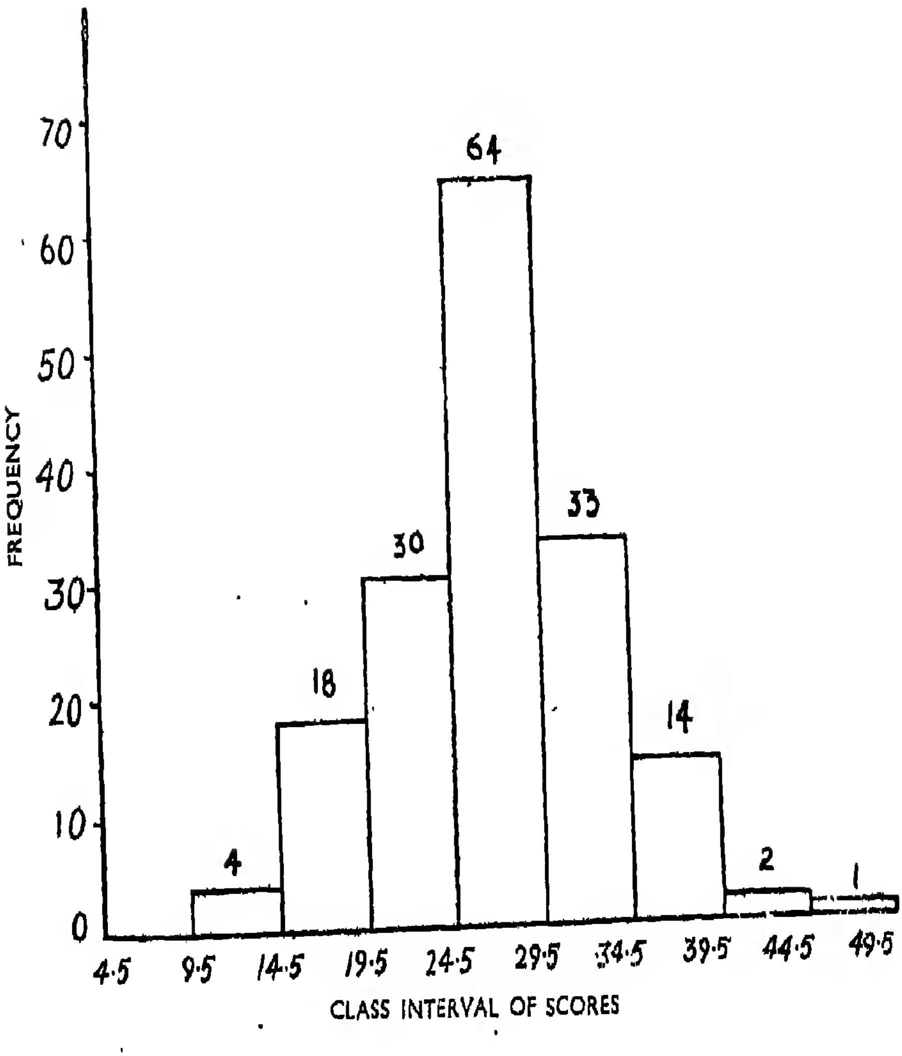
N=290



DEHRADUN BOARD

N = 166

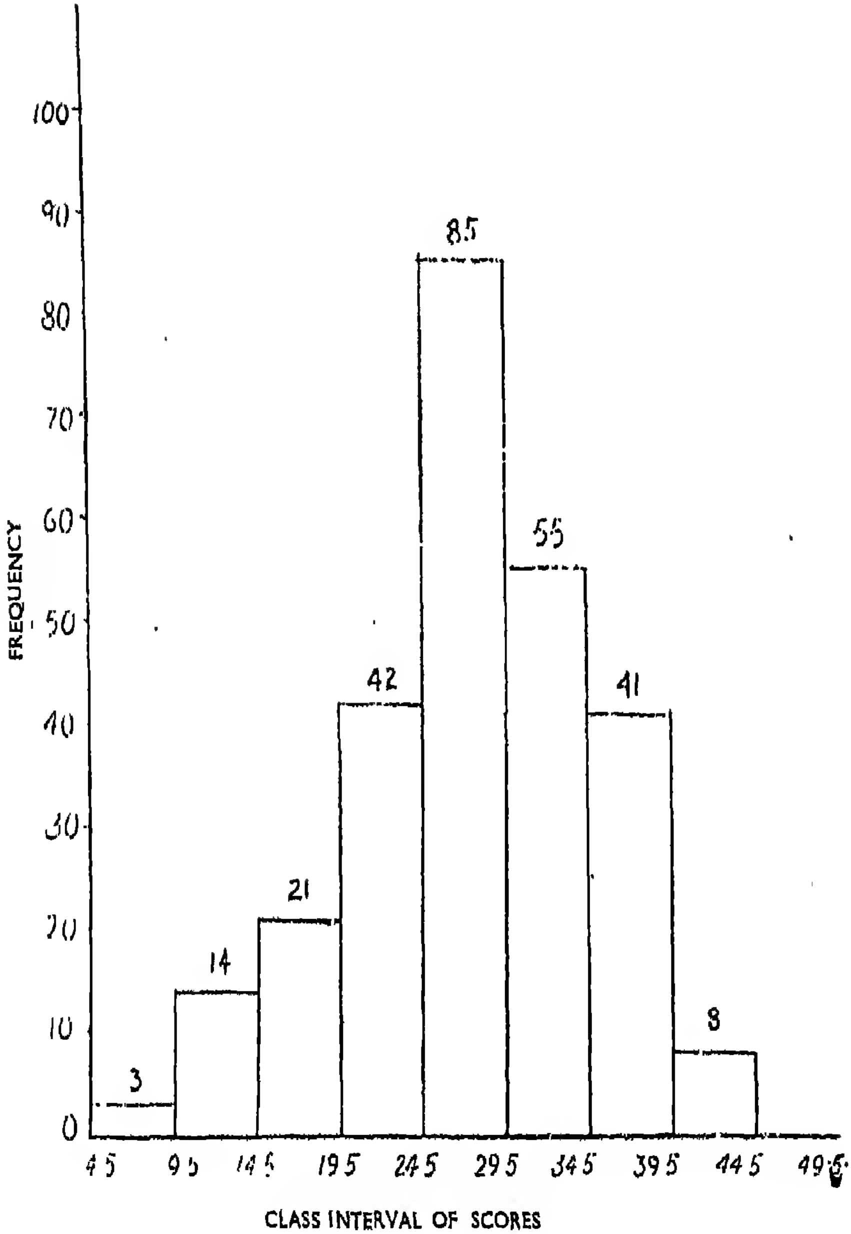
TABLE B(II)-2

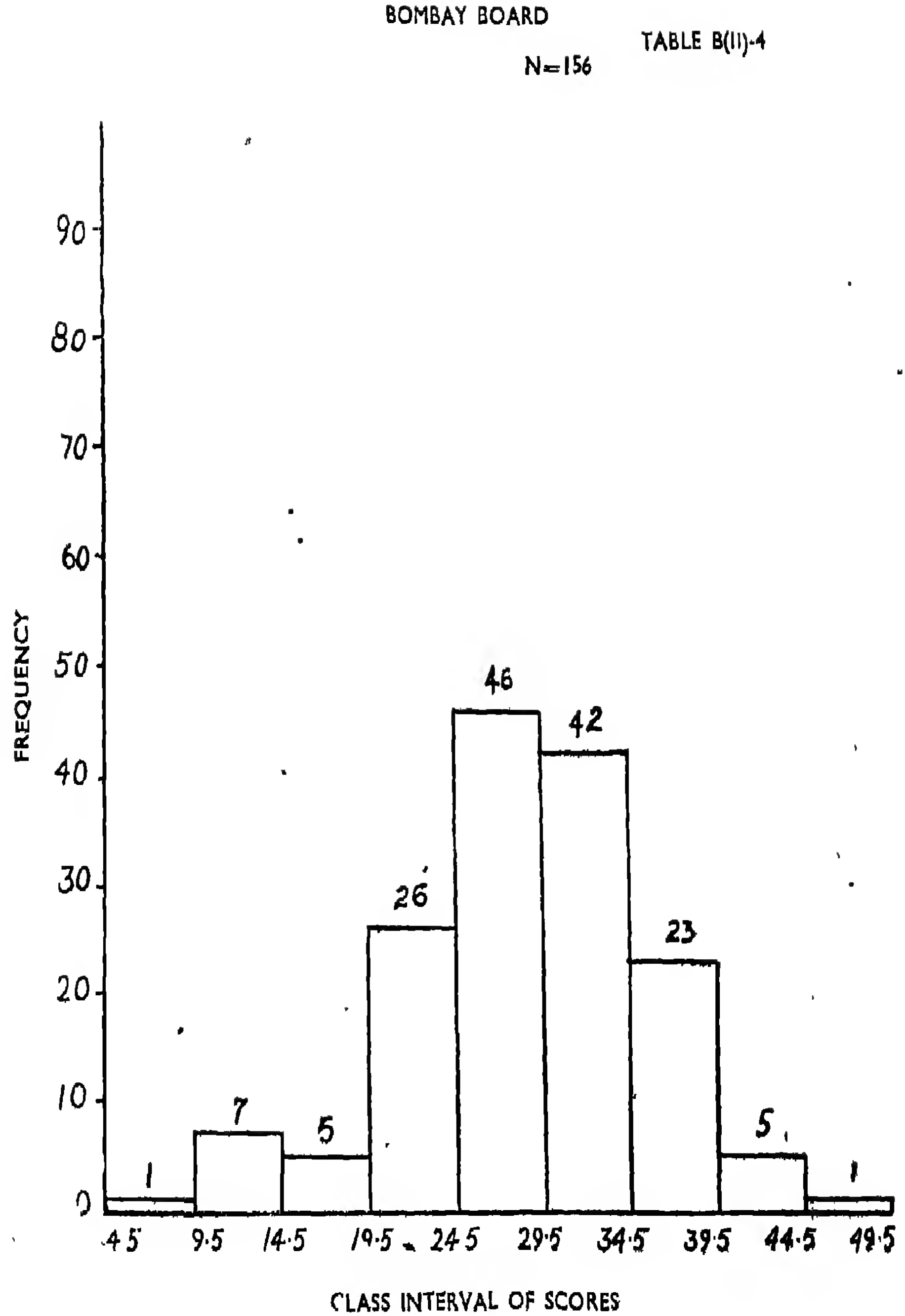


BANGALORE BOARD

TABLE B(II)-3

N—269

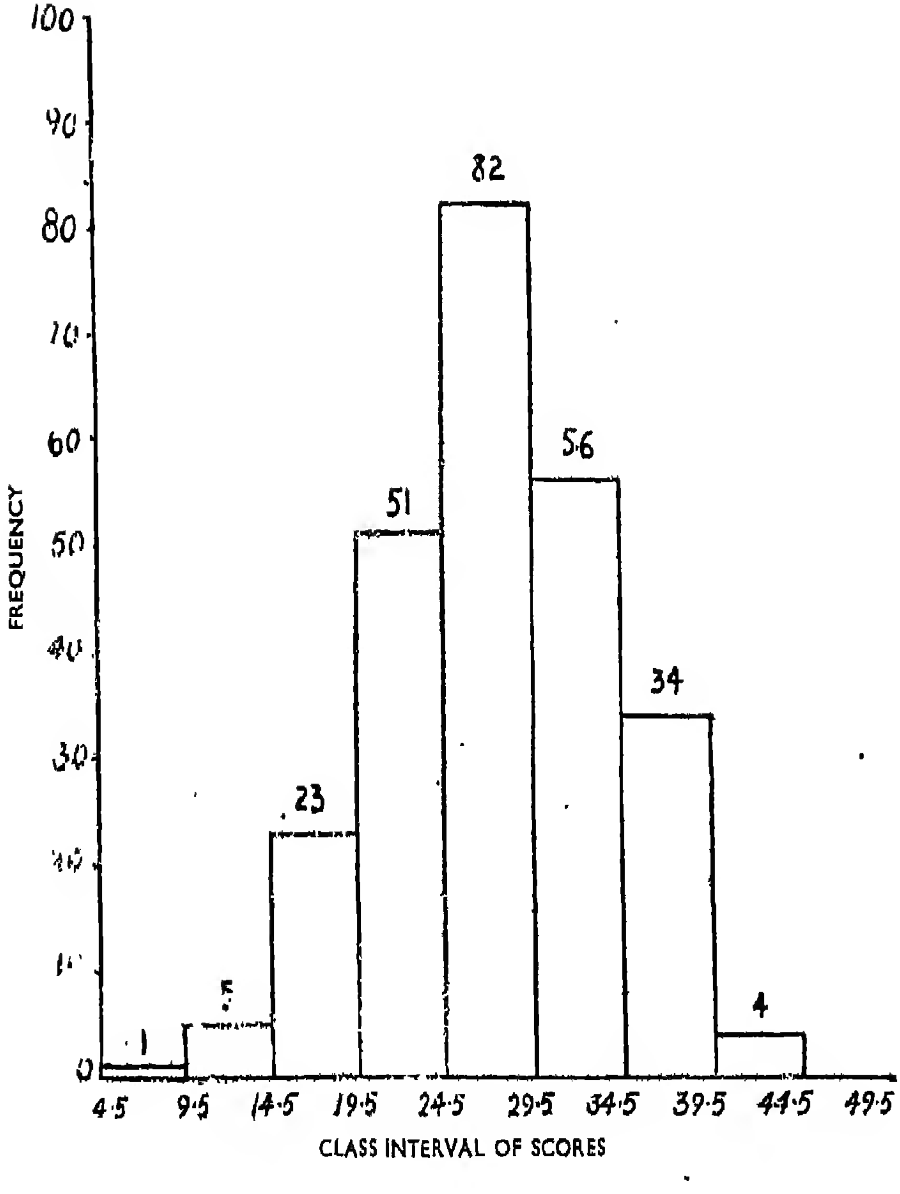


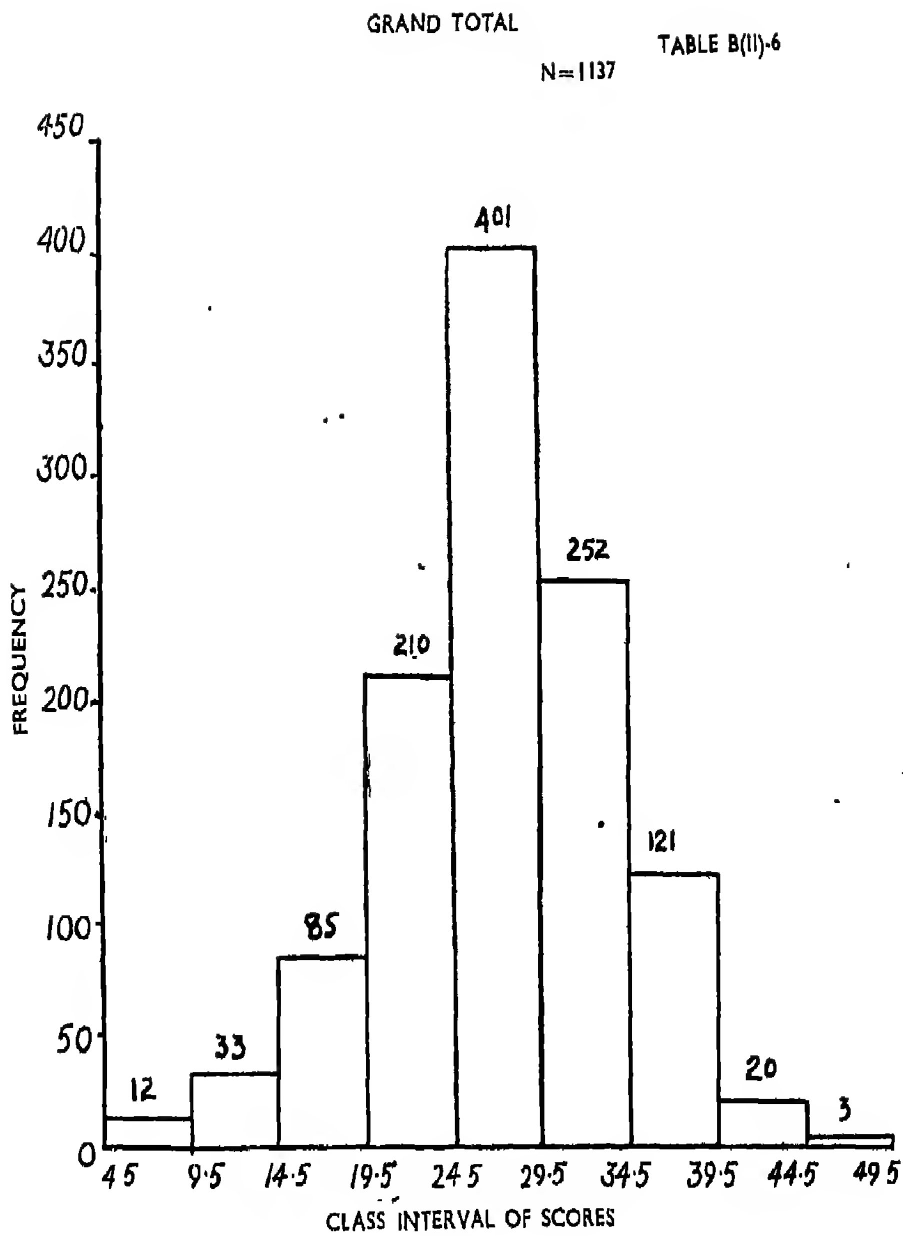

BOMBAY BOARD
TABLE B(II)-4
N=156
FREQUENCY
90
80
70
60
50
40
30
20
10
0
1
7
5
26
46
42
23
5
1
4·5
9·5
14·5
19·5
24·5
29·5
34·5
39·5
44·5
49·5
CLASS INTERVAL OF SCORES

CALCUTTA BOARD

TABLE B(II)-5

N - 256




GRAND TOTAL
TABLE B(II)-6
N=1137
FREQUENCY
450
400
350
300
250
200
150
100
50
0
401
252
210
121
85
33
12
20
3
4 5
9·5
14·5
19·5
24 5
29·5
34·5
39·5
44·5
49 5
CLASS INTERVAL OF SCORES

FREQUENCY DISTRIBUTION OF SCORES ON PROJECT REPORT (INTERVIEW BOARD WISE)
DELHI BOARD

TABLE B(iii)-1

N=290

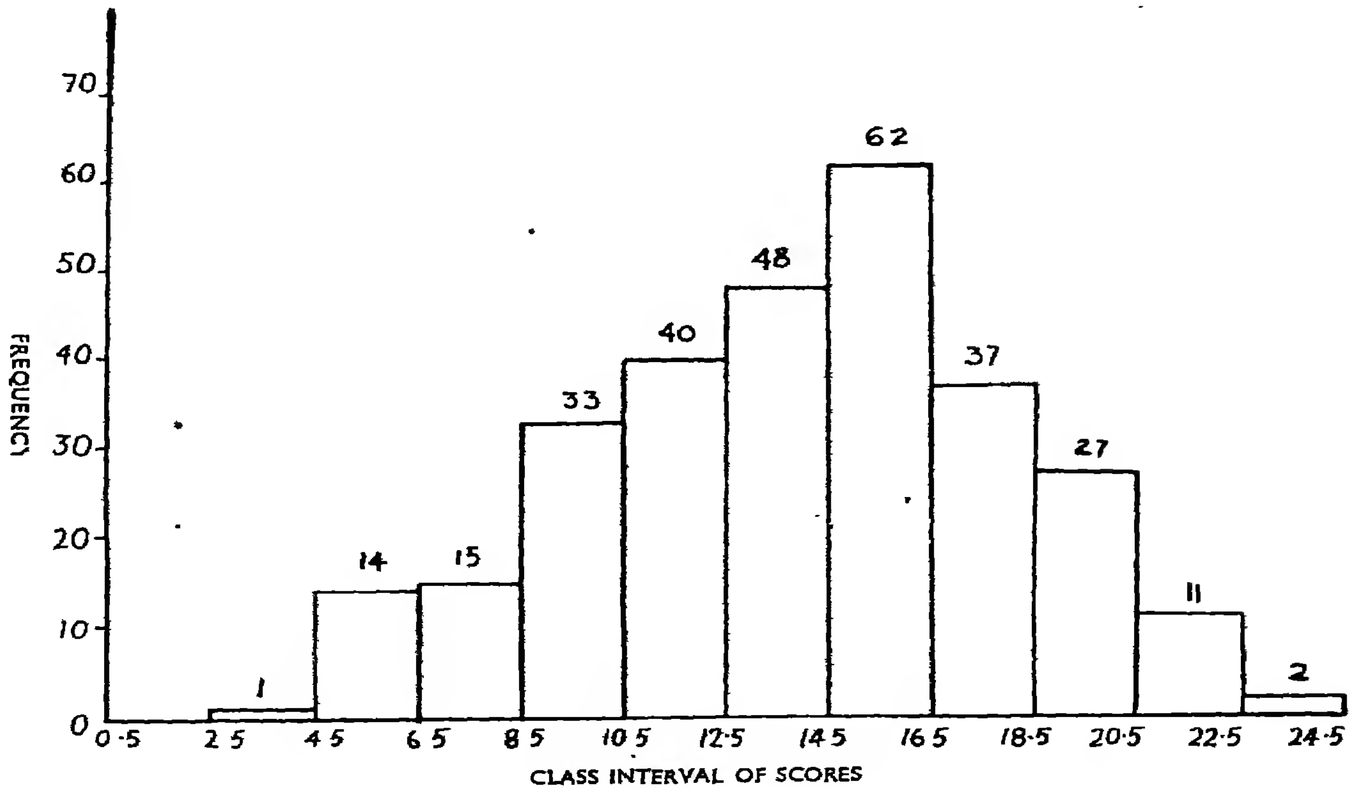
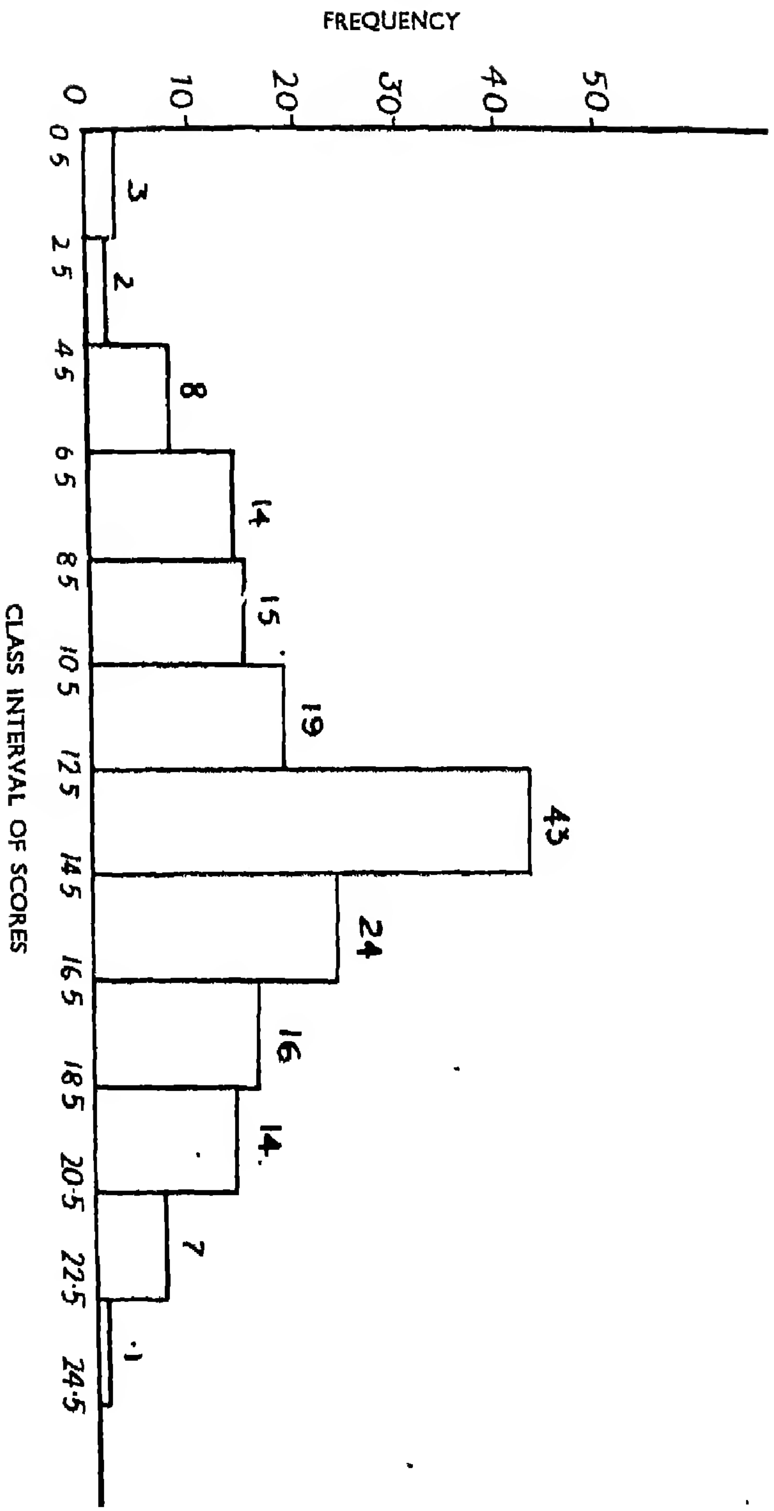


TABLE B(iii)-2

DEHRADUN BOARD

N=166



BANGALORE BOARD N = 269 B(iii)-3

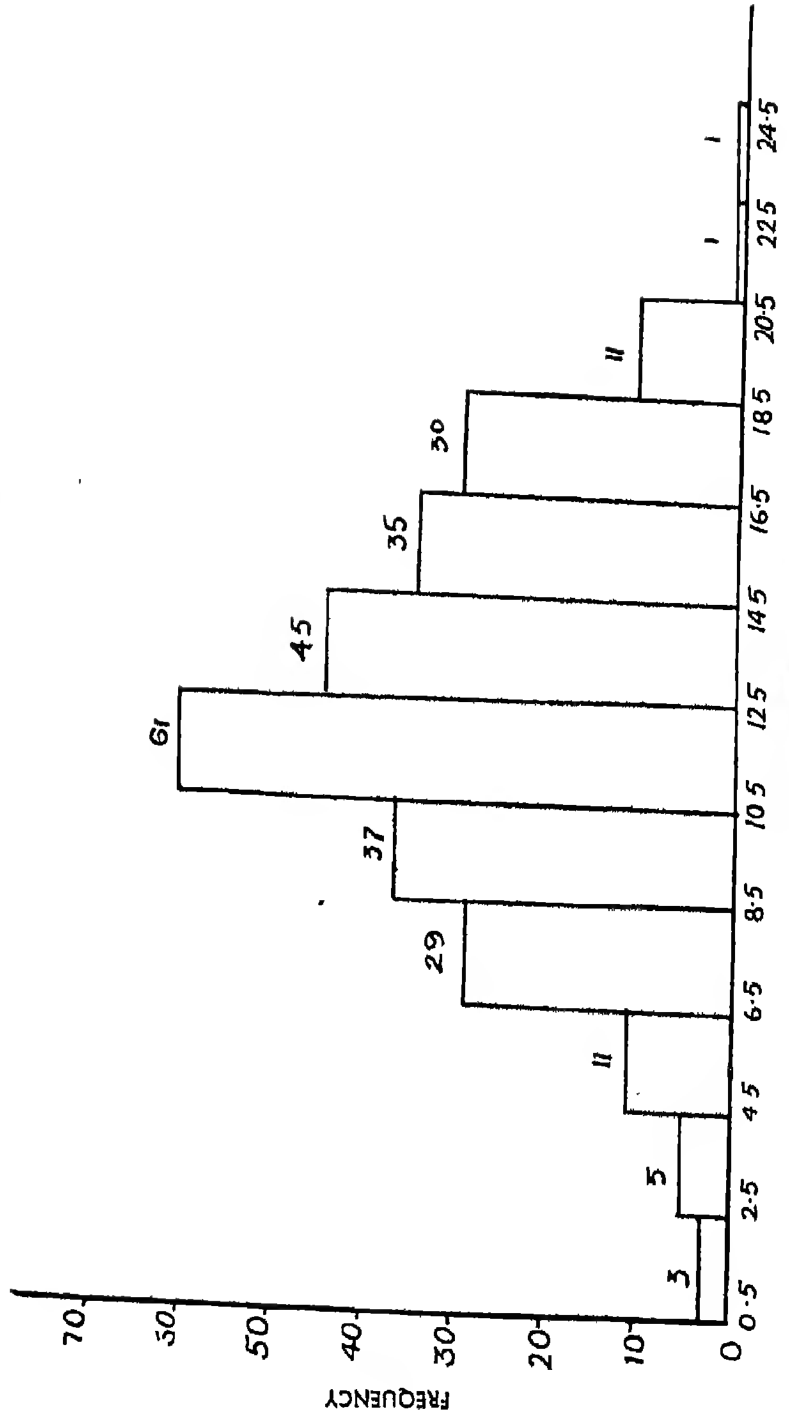


TABLE B(iii)-4

BOMBAY BOARD

N = 156

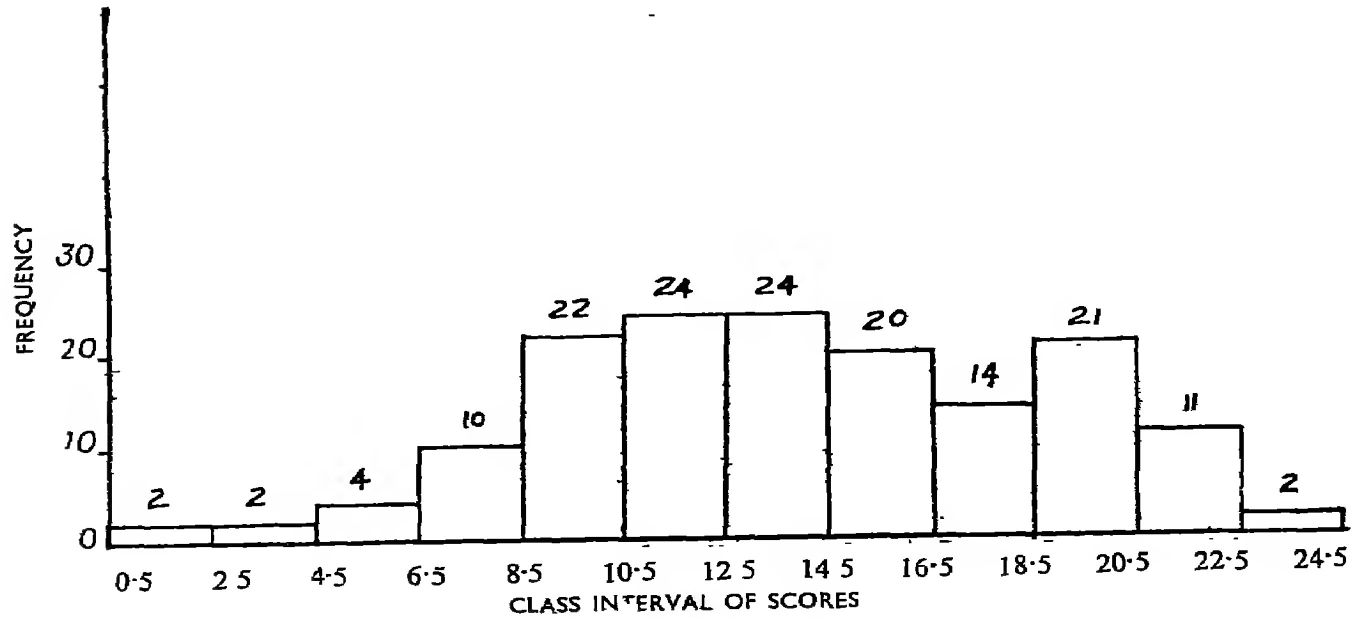


TABLE B(iii)-5

CALCUTTA BOARD

N=256

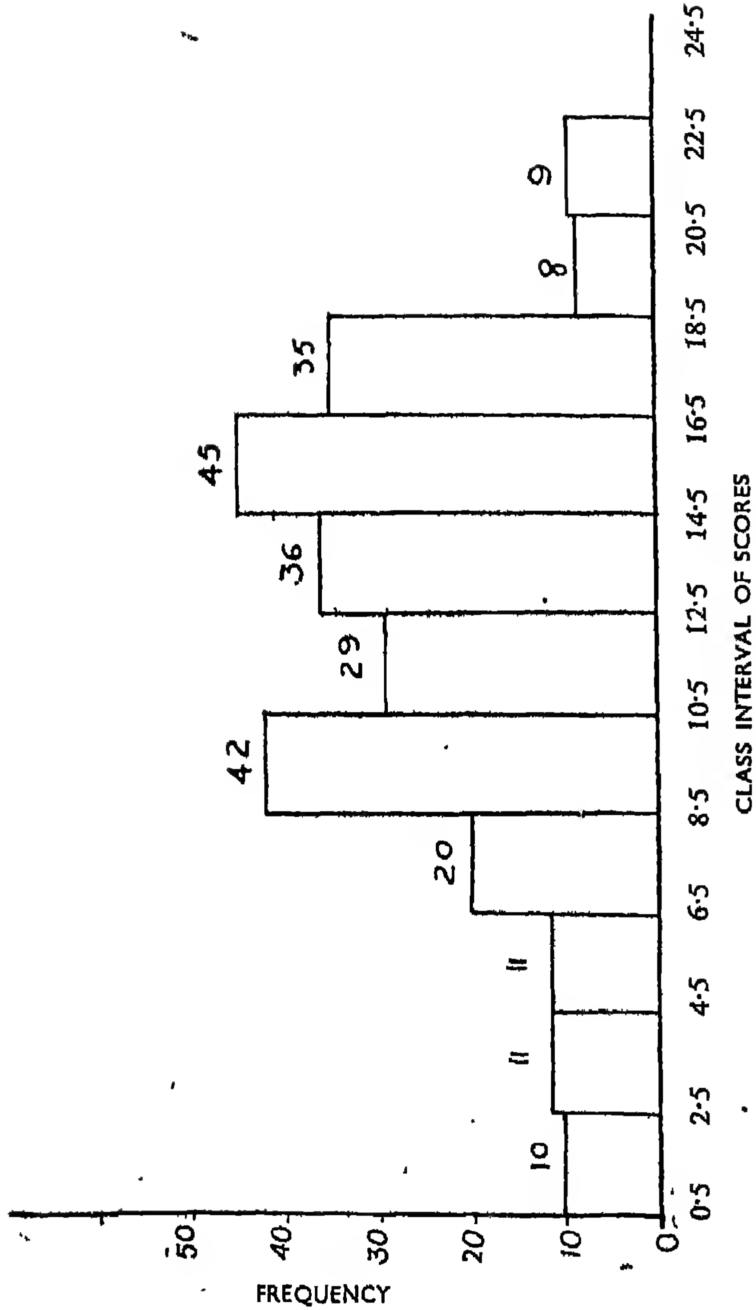
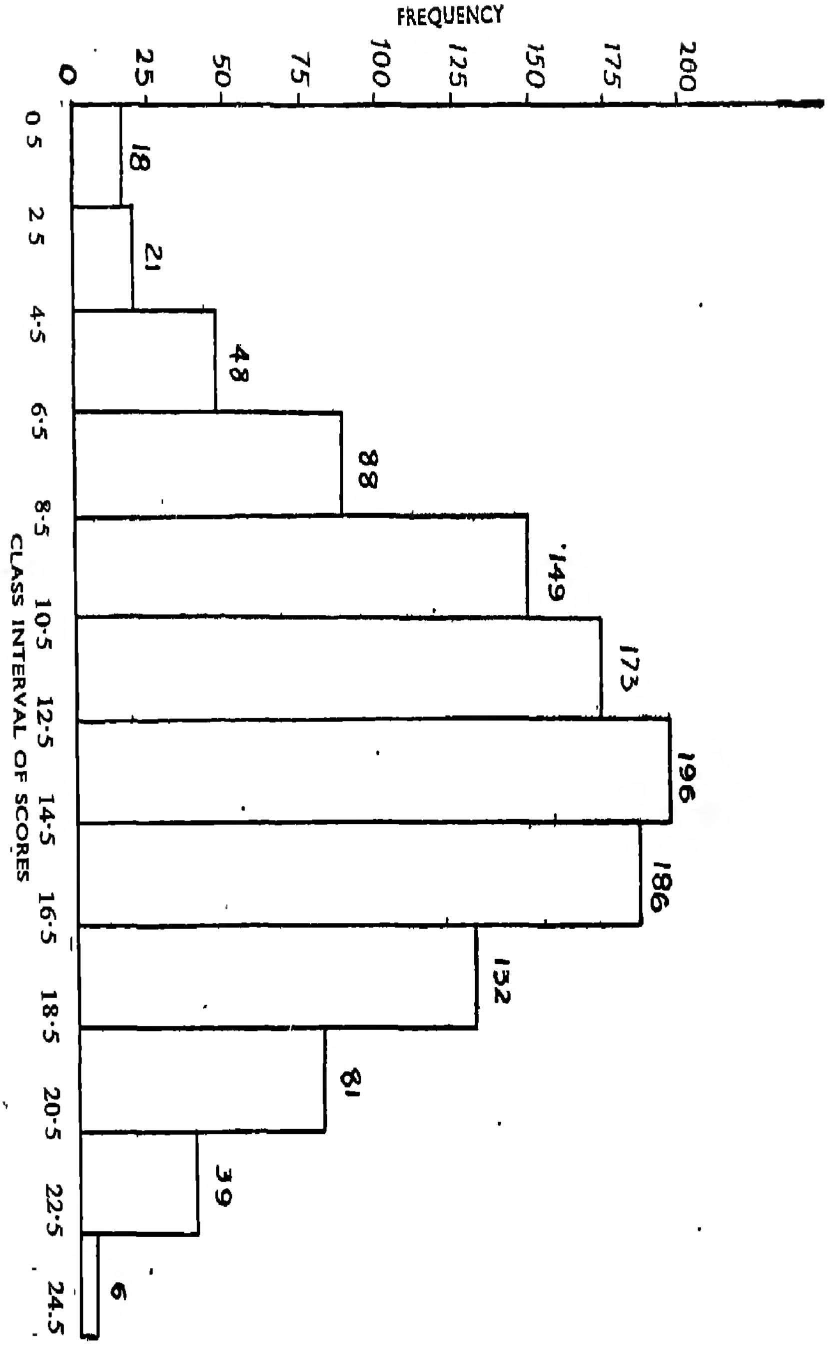


TABLE B(iii)-6

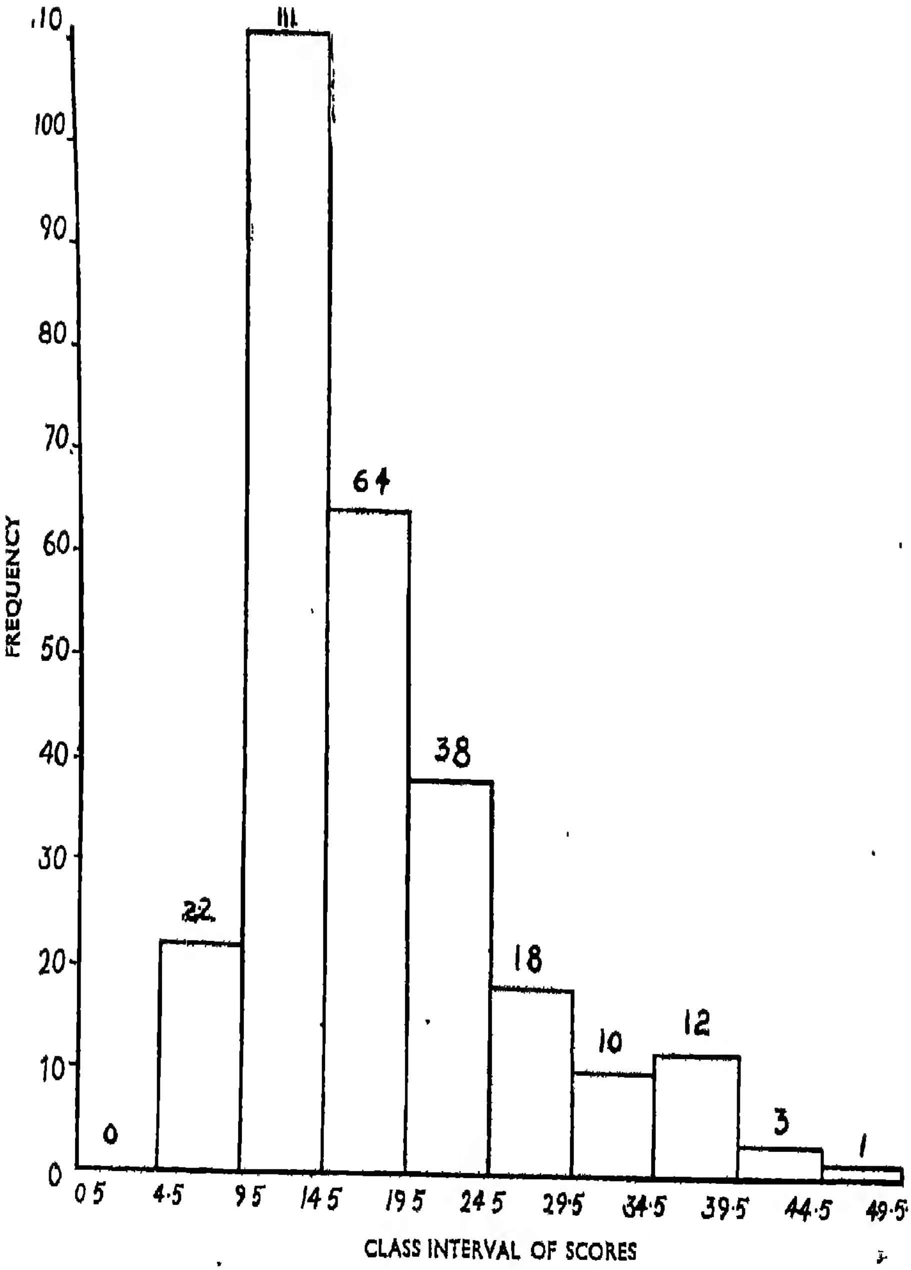
GRAND TOTAL
N=1137

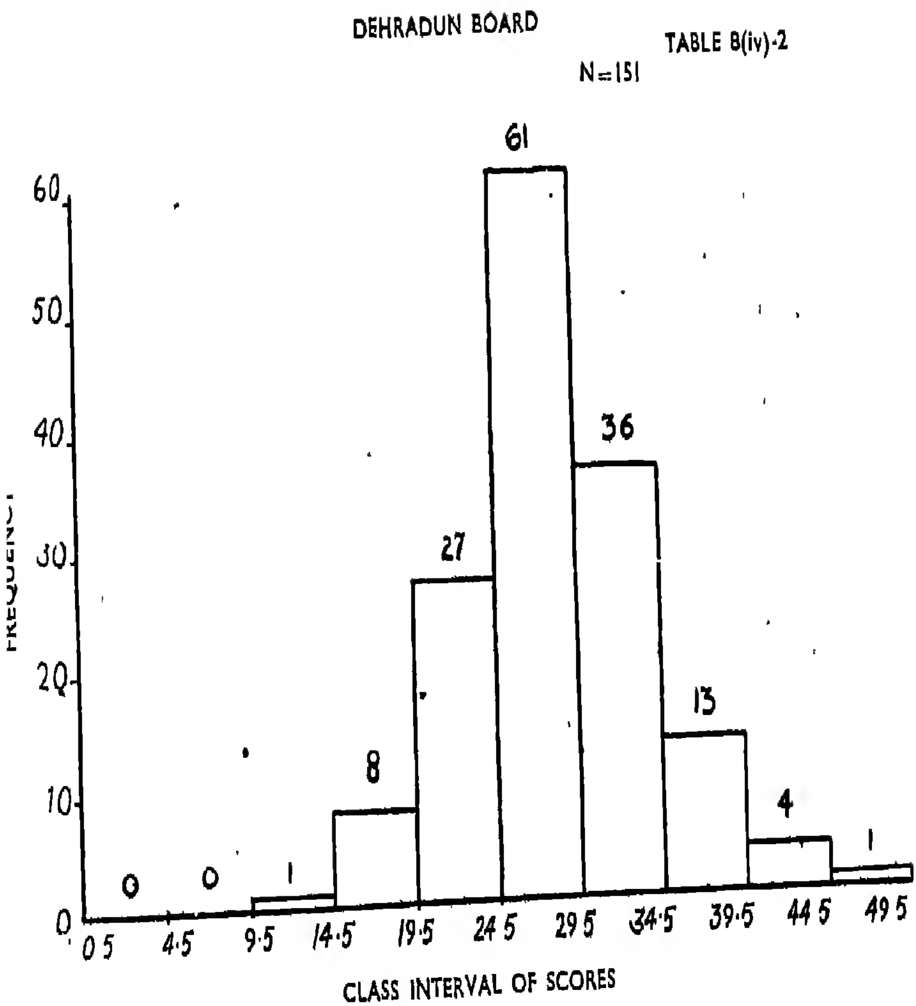


FREQUENCY DISTRIBUTION OF SCORES ON INTERVIEW BOARDWISE
DELHI BOARD

TABLE B(Iv)-I

N - 279

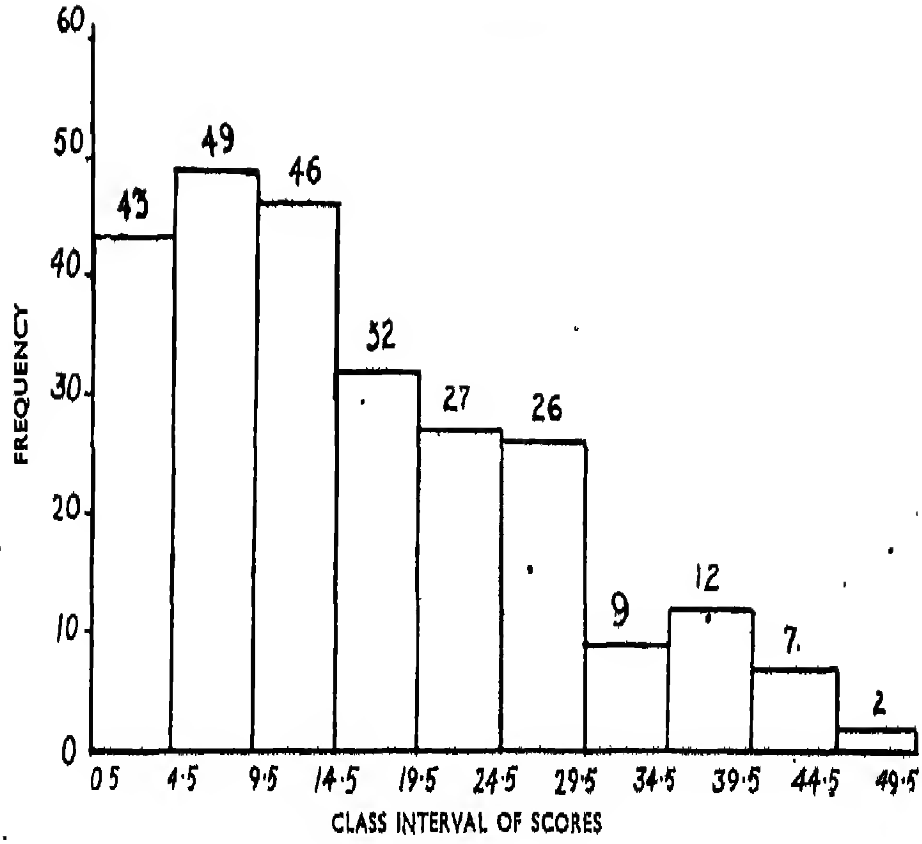



DEHRADUN BOARD
TABLE B(iv)-2
N=151
61
36
27
13
8
4
0
0
1
1
60
50
40
30
20
10
0
0 5
4·5
9·5
14·5
19·5
24 5
29 5
34·5
39·5
44 5
49 5
CLASS INTERVAL OF SCORES

BANGALORE BOARD

TABLE B(Iv)-3

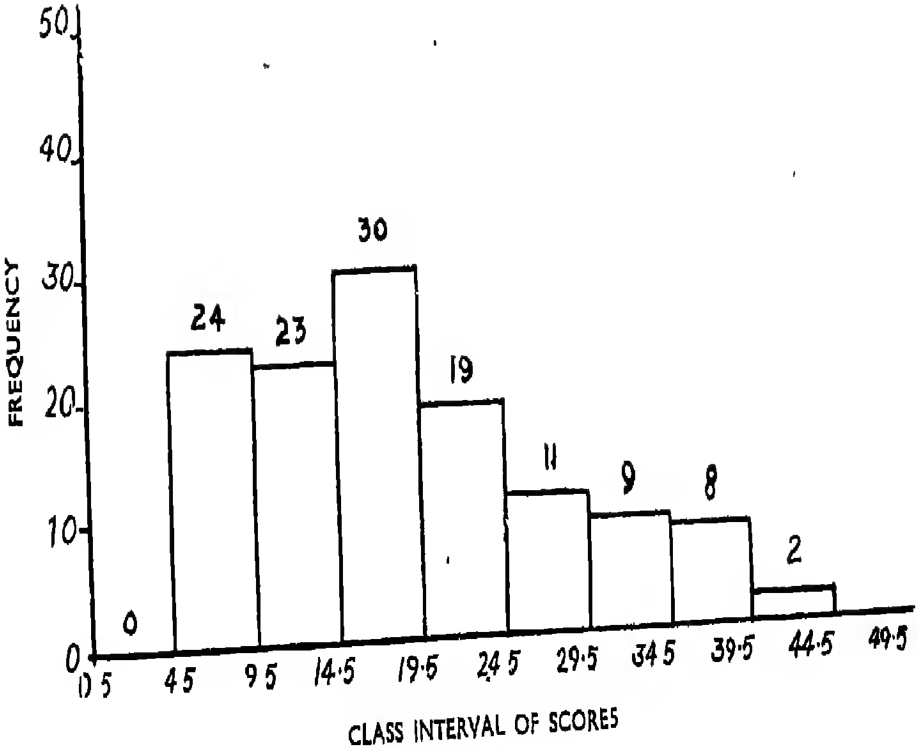
N=253

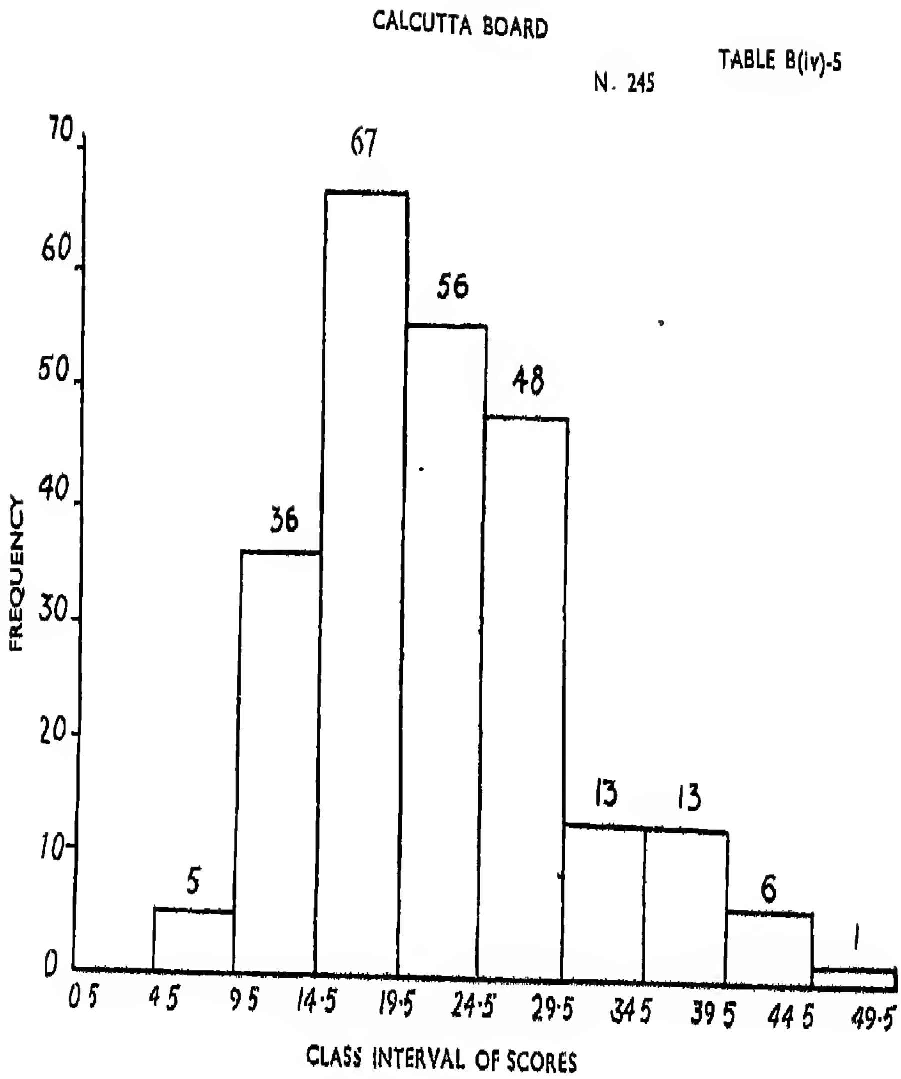


BOMBAY BOARD

TABLE B(iv)-4

N=126

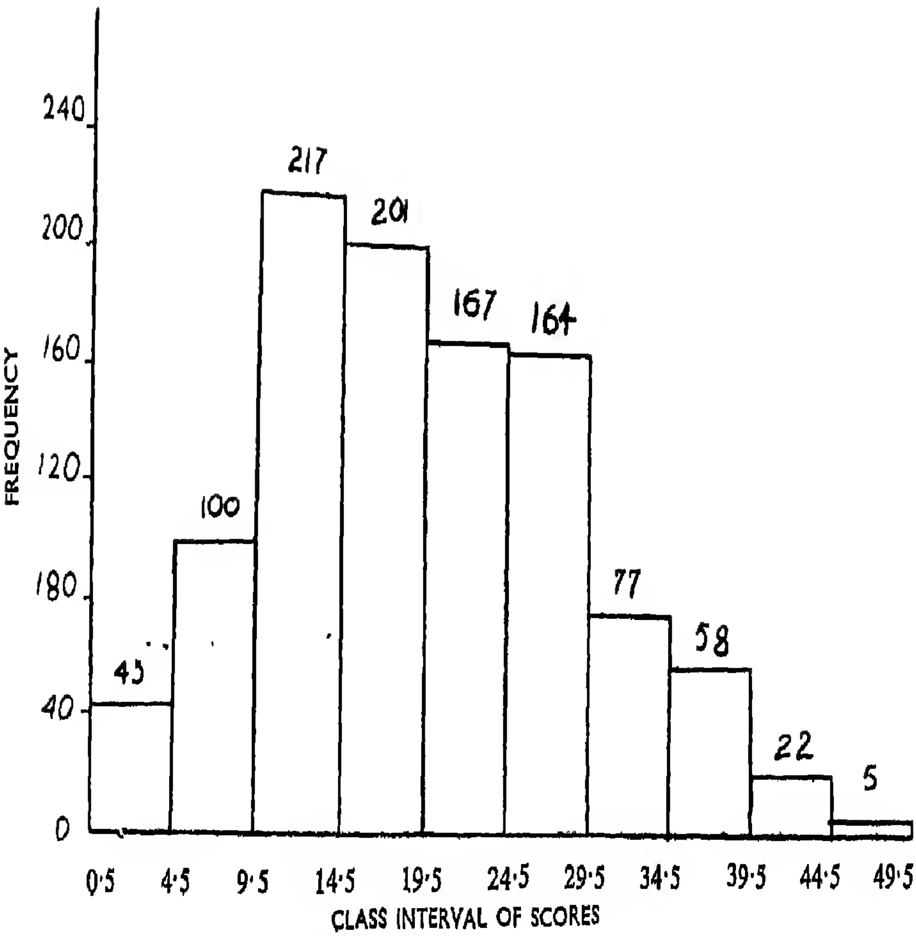



CALCUTTA BOARD
TABLE B(iv)-5
N. 245
FREQUENCY
70
60
50
40
30
20
10
0
67
36
56
48
5
13
13
6
1
0 5
4 5
9 5
14·5
19·5
24·5
29·5
34 5
39 5
44 5
49·5
CLASS INTERVAL OF SCORES

GRAND TOTAL

TABLE B(Iv)-6

N=1054



APPENDIX XI

DATA FOR THE PREDICTIVE VALIDITY OF THE TEST, YEAR 1964

S. No.	S.T.S. Total	(a) Rank	Marks in S.A.T.	(b) Rank	% age of Marks at Hr. Sec.	(c) Rank	%age of Marks at B.Sc. (final)
1.	142	41.5	52	64	84.8	2	86.4
2.	173	12	89	13	79.6	5	70.4
3.	139	49	47	72	75.4	10	62.1
4.	136	54.5	49	70.5	74	19	58.0
5.	138	51.5	52	64	70.3	31	67.1
6.	150	29	62	45	67.6	37	62.1
7.	139	49	55	58.5	77.2	6	73.2
8.	132	67	55	58.5	63.4	50	67.8
9.	133	65	73	34	62.2	55	72.0
10.	152	26	59	49	72.2	26	65.4
11.	148	32.5	88	14.5	52.6	71	51.6
12.	148	32.5	81	23	65.4	44	65.0
13.	130	74	69	37.5	68.7	36	65.2
14.	156	22.5	58	52.5	65.4	44	53.0
15.	154	24	61	46	70.5	30	58.8
16.	129	76	55	58.5	55	68	62.4
17.	134	62	57	55	64	48	66.4
18.	139	49	44	75	50.3	73	55.5
19.	136	54.5	69	37.5	68.8	34.5	55.5
20.	131	70.5	50	68	73.6	21.5	73.4
21.	129	76	54	62	66.5	39	73.0
22.	151	27	71	36	76.7	7	70.4
23.	164	16.5	84	20.5	60.3	57.5	79.3
24.	138	51.5	35	77	53.4	70	56.0
25.	131	70.5	65	43	59.9	61	61.3
26.	156	22.5	67	40	53.8	69	58.0
27.	135	58	50	68	65.3	46	67.2
28.	189	6	77	28.5	60.3	57.5	57.2
29.	131	70.5	70	47	62.3	54	63.1
30.	140	46.5	49	70.5	61.3	56	68.0
31.	164	16.5	85.5	18	60	59.5	79.3
32.	134	62	59	49	74.2	16.5	65.7
33.	145	37	75	32	58.4	65	62.4
34.	141	44.5	51	66	48.4	77	47.0
35.	142	41.5	55	58.5	63	52	51.0
36.	150	29	50	68	64.7	47	62.4
37.	180	10	77	28.5	56.5	67	60.9
38.	202	4	103	6	75.2	12	74.5

APPENDIX XI (Contd.)

DATA FOR THE PREDICTIVE VALIDITY OF THE TEST, YEAR 1964

(d) Rank	$\lvert d_1 \rvert$ (a—d)	$\lvert d_2 \rvert$ (b—d)	$\lvert d_3 \rvert$ (a—c)	$\lvert d_4 \rvert$ (b—c)	$\lvert d_5 \rvert$ (c—u)	$\lvert d_6 \rvert$ (a—b)	$\lvert d_7 \rvert$ (a+b+c+d)
2	39.5	62.0	39.5	62.0	0.0	22.5	109.5
23.5	11.5	9.5	7.0	8.0	18.5	1.0	53.5
50.5	1.5	21.5	39.9	62.0	40.5	23.0	181.5
64	9.5	6.5	35.5	51.5	45.0	16.0	208.0
31	20.5	33.0	20.5	33.0	0.0	12.5	177.5
50.5	21.5	4.5	8.0	8.0	13.5	16.0	161.5
16	33.0	41.5	43.0	52.5	10.0	9.5	129.5
29	38.0	29.5	17.0	8.5	21.0	8.5	204.5
21	44.0	13.0	10.0	21.0	34.0	31.0	175.0
36	10.0	13.0	0.0	23.0	10.0	23.0	137.0
73.5	41.0	59.0	38.5	56.5	2.5	18.0	191.5
38	5.5	15.0	11.5	21.0	6.0	9.5	137.5
37	37.0	0.5	38.0	1.5	1.0	36.5	184.5
71	48.5	18.5	21.5	8.5	27.0	30.0	190.0
62	38.0	16.0	6.0	16.0	32.0	22.0	162.0
48	28.0	10.5	8.0	9.5	20.0	17.5	250.5
33	29.0	22.0	14.0	7.0	15.0	07.0	198.0
69	20.0	6.0	24.0	2.0	4.0	26.0	266.0
69	14.5	31.5	20.0	3.0	34.5	17.0	195.5
15	55.5	53.0	49.0	46.5	6.5	1.5	175.0
17	59.0	45.0	37.0	23.0	22.0	14.0	194.0
23.5	3.5	12.5	20.0	29.0	28.0	9.0	93.5
9.5	7.0	11.0	41.0	37.0	3.0	4.0	104.0
67	15.0	10.0	18.0	7.0	6.0	25.5	265.5
55	15.5	12.0	9.5	18.0	5.0	27.5	229.5
64	41.5	24.0	46.0	29.0	5.0	17.5	195.5
30	28.0	38.0	12.0	28.0	16.0	10.0	202.0
66	60.0	37.5	51.5	29.0	8.5	22.5	158.0
42	28.5	5.0	16.5	7.0	12.0	23.5	213.5
27.5	19.0	43.0	9.5	14.5	28.5	24.0	200.5
9.5	7.0	8.5	43.0	41.5	50.0	1.5	103.5
35	27.0	14.0	45.5	32.5	18.5	13.0	162.5
48	11.0	16.0	28.0	33.0	17.0	5.0	182.0
76	31.5	10.0	32.5	11.0	1.0	21.5	263.5
75	33.5	16.5	10.5	6.5	25.0	17.0	227.0
48	19.0	20.0	18.0	21.0	1.0	59.0	192.0
57	47.0	28.5	57.0	38.5	10.0	18.5	162.5
41	10.0	8.0	8.0	6.0	2.0	2.0	36.0

S. No.	S.T.S. Total	(a) Rank	Marks in S.A.T.	(b) Rank	% age of Marks at Hr. Sec.	(c) Rank	%age of Mark at B.Sc. (final)
39.	143	39	55	58.5	76	9	72.6
40.	145	37	45	74	75.3	11	74.9
41.	145	37	67	40	49	74.5	55.5
42.	131	70.5	55	58.5	49	74.5	41
43.	135	58	52	64	57.4	66	60.6
44.	158	20	67	40	65.8	42	61.7
45.	238	1	127	2	63	52	61
46.	134	62	58	52.5	60	59.5	69.9
47.	141	44.5	63	44	72.5	24	51.7
48.	157	21	74	33	68.8	34.5	72.8
49.	135	58	78	27	59	62	62.8
50.	172	13	95	8.5	74	19	68
51.	186	7	90	12	63.7	49	62.6
52.	177	11	93	10	73.4	23	66.1
53.	218	.2	116	3	82.2	3	83.6
54.	163	18	105	4.5	76.3	8	78.7
55.	165	15	85	18	72.3	25	59
56.	133	65	80	24.5	74	19	69
57.	150	29	85	14.5	65.4	44	62.5
58.	184	8	95	8.5	66.7	38	64.2
59.	159	19	80	24.5	58.6	63.5	66.8
60.	213	3	105	4.5	74.2	16.5	62.8
61.	140	46.5	76	30.5	63	52	58
62.	135	58	82	22	51.5	72	62
63.	171	14	98	7	65.9	41	80
64.	142	41.5	46	73	70.9	28.5	74.6
65.	149	31	91	11	85.5	1	80
66.	153	25	66	42	75	13.5	64.4
67.	142	41.5	58	52.5	73.6	21.5	60
68.	146	34.5	72	35	70.9	28.5	60.3
69.	131	70.5	59	49	58.6	63.5	51.6
70.	129	76	84	20.5	69	33	64.8
71.	182	9	86	16	69.6	32	71
72.	131	70.5	76	30.5	47	76	61.6
73.	137	53	85	11	72	27	92.5
74.	146	34.5	79	26	66	40	80
75.	198	5	133	1	74.5	15	80
76.	133	65	58	52.5	75	13.5	80
77.	135	58	40	76	80.8	4	72.7

(d) Rank	$\|d_1\|$ (a—d)	$\|d_2\|$ (b—d)	$\|d_3\|$ (a—c)	$\|d_4\|$ (b—c)	$\|d_5\|$ (c—d)	$\|d_6\|$ (a—b)	$\|d_7\|$ (a+b+c+d)
20	19.0	38.5	30.0	49.5	11.0	19.5	126.0
12	15.0	62.0	26.0	63.0	1.0	37.0	134.0
69	32.0	29.0	37.5	34.5	5.5	3.0	220.5
77	6.5	18.5	4.0	16.0	2.5	12.0	280.4
58	0.0	6.0	8.0	2.0	8.0	6.0	246.0
53	33.0	13.0	22.0	2.0	11.0	20.0	155.0
56	55.0	54.0	51.0	50.0	4.0	1.0	111.0
26	37.0	27.5	2.5	7.0	34.5	9.5	199.0
72	27.5	28.0	20.5	20.0	48.0	0.5	184.5
18	3.0	15.0	13.5	1.5	16.5	12.0	106.5
43.5	14.5	15.5	4.0	25.0	18.5	31.0	190.5
27.5	13.5	19.0	6.0	10.5	8.5	4.5	68.0
45	38.0	33.0	42.0	37.0	4.0	5.0	113.0
34	23.0	24.0	12.0	13.0	11.0	1.0	78.0
3	1.0	0.0	1.0	0.0	0 0	1.0	11.0
11	7.0	6.5	10.0	3.5	3.0	13.5	41.5
61	46.0	43.0	10 0	7.0	36.0	3.0	119.0
26	39.0	1.5	46.0	5.6	7.0	40.5	134.5
46	17.0	31.5	15.0	29.5	2.0	14.5	133.5
41	33.0	32.5	30.0	29.5	3.0	0.5	95.5
32	13.0	7.5	44.5	39.0	31.5	5.5	138.5
43.5	40.5	39.0	13.5	12.0	27.0	1.5	67 .5
64	17.5	33.5	5.5	21.5	12.0	16.0	193.0
52	6.0	30.0	14.0	52.0	20.0	36.0	204.0
6	8.0	1.0	27.0	34.0	35.0	7.0	68.0
13	28.5	60.0	13.0	44.5	15.5	31.5	156.0
6	25.0	5.3	30.0	10.0	5.0	20.0	49.0
40	15.0	2.0	11.5	28.5	26.5	17.0	120.5
60	18.5	7.5	20.0	31.0	38.5	11.0	175.5
59	24.5	24.0	6.0	6.5	30.5	0.5	157.0
73.5	3.5	23.5	7.0	14.5	10.0	21.5	256.5
39	37.0	18.5	43.0	12.5	6.0	55.5	168.5
22	13.0	6.0	23.0	16.0	10.0	7.0	79.0
54	16.5	23.5	5.5	45.5	22.0	40.0	231.0
1	52.0	17.0	26.0	9.0	26.0	35.0	99.0
6	28.5	20.0	5.5	14.0	34.0	7.5	106.5
6	1.0	5.0	10.0	14.0	9.0	4.0	27.0
6	59.0	45.5	51.5	39.0	7.5	2.5	137.0
19	39.0	57.0	54.0	72.0	15.0	18.0	157.0
	S.S. 66907.25	59872.50	58661.50	69145.50	33415.25	30244.00	T.S. 12011.00
							M 155.98
							S.S. 2156988.25

p :—Spearman Rank correlation Coefficient.

$$1-\frac{6\sum di^2}{n(n^2-1)}$$

W :—Kendall Coefficient of concordance (measure of overall correlation when there are 'K' sets of rankings of the same 'n' objects)

$$\frac{12\ S}{K^2(n^3-n)}$$

Where S is the sum of the squares of the deviations of the total of the ranks obtained by each object from the average of these totals.

k :—No. of sets of rankings.

n :—Objects or persons

Testing the significance of W :—

$$W \quad \frac{12\,(s\quad 1)}{k^2\,(n^3-n)\ ;\ 24} \ \therefore F_{(N_1,\,N_2)} \ F = \frac{(k-1)\ W}{1-W}$$

Where N_1: $=(n-1)-2/k$.

N_2: $=(k-1)[(n-1)-2/k)]$

1. Correlation between the total scores on the Science Talent Search Tests Year 1964 and the percentage of marks scored at the B.Sc. (Final) by the awardees of 1964.

   p = 0.12

   Not significant at 5% level

2. Correlation between the scores on the Science Aptitude Test of the year 1964 and the percentage of marks scored at the B.Sc. (Final)

   p = 0.225

   Significant at 0.05 level

3. Correlation between the total scores on the Science Talent Search Tests Year 1964 and the percentage of marks scored at the Higher Secondary by the Awardees of 1964.

   p = 0.23

   Significant at 5% level

4. Correlation between the scores on the Science Aptitude Test of the year 1964 and the percentage of marks scored at the Higher Secondary by the Awardees of year 1964.

   p = 0.10

   Not Significant at 5% level

5. Correlation between the total S.T.S. marks and marks in the S.A.T. scored by the awardees of year 1964.

   p 0.60

   Significant at 0.01 level

6. Correlation between the marks scored in Science subjects at B.Sc. (Final) and in Higher Secondary by the awardees of year 1964.

   p 0.56

   Significant at 0.01 level

7. The co-efficient of con-cordance 'W' i.e. the measure of overall correlation between given four sets of Rankings is

   W 0.46

$$F_{(76,\,227)} = 2.6 > F_{(76,\,227)}\ 0.01 = 1.49$$

Significant at 0.01 level.

APPENDIX XII

NEEDED RESEARCH

(a) Analysis of the data collected with a view to determine the discriminative and difficulty value of the test items of the Science Aptitude Test in order to assess the effectiveness of the different items constituting the test ;

(b) Determination of the internal consistency of the test items together with the conceptual analysis of these items to work out construct and concurrent validities of the tools.

(c) Determination of the empirical and predictive validities of the tools of selection.

(d) A longitudinal study of the selected awardees to correlate their success during their formal education with the on-the-job performance.

(e) To correlate the relative role of the different anticedent variables in predicting job success, the variables being :

(i) Coginitive (S.A.T. etc.)

(ii) Personality variables (drive, initiative, achievement-motivation and other personality characteristics).

(iii) Environmental variables home, school and family conditions.

(f) To determine the inter-correlations between different variables like sub-tests of the S.T.S., income level, tests of intelligence and achievement etc.

(g) To discuss the nature of score distributions of the various tools of selection.

(h) To conduct further research work like the factorial analysis of the sub-tests of the S.A.T. ; inter-correlations of the various tools of selection ; a factorial analysis to ascertain the factorial content of the S.A.T. and to examine if a single factor runs predominantly through all the selection tests, which could be called a factor of scientific aptitude.

(i) To study the personality structure of the high achievers as against a control group of low achievers.

These research studies will be helpful in improving the S.T.S. Scheme.

APPENDIX XIII

CORRELATIONAL FIGURES—AT A GLANCE

Sr. No.	Specification	n	r	Significance Level
1.	Physics (High School) X Chemistry (High School)	228	0.560	at 1 % level
2.	Physics (High School) X Mathematics (High School)	222	0.373	at 1 % level
3.	Physics (High School) X Biology (High School)	65	0.144	Not significant at 5 % level
4.	Chemistry (High School) X Mathematics (High School)	222	0.423	Significant at 1 % Level
5.	Chemistry (High School) X Biology (High school)	66	0.073	Not Significant at 5 % level
6.	Mathematics (High School) X Biology (High School)	60	0.138	—do—
7.	Physics (High School) X General Science (High School)	85	0.347	Significant at 5% level
8.	Chemistry (High School) X General Science (High School)	84	0.296	—do—
9.	Mathematics (High School) X General Science (High School)	80	0.343	—do—
10.	S. A. T. X Physics (High School)	220	0.055	Not Significant at 5% level
11.	S. A. T. X Chemistry (High School)	220	0.056	—do—
12.	S. A. T. X Mathematics (High School)	218	0.038	—do—
13.	S.A.T. X Biology (High School)	64	—0.061	—do—
14.	S.A.T. X General Science (High School)	88	—0.044	—do—
15.	Essay X Physics (High School)	220	0.078	—do—
16.	Essay X Chemistry (High School)	220	0.067	—do—
17.	Essay X Mathematics (High School)	218	0.068	—do—
18.	Essay X Biology (High School)	64	0.122	—do—
19.	Essay X General Science (High School)	88	—0.144	—do—
20.	Project X Physics (High School)	220	0.051	—do—
21.	Project X Chemistry (High School)	220	—0.024	—do—

Sr. No.	Specification	n	r	Significance Level
22.	Project X Mathematics (High School)	218	—0.011	—do—
23.	Project X Biology (High School)	64	—0.134	—do—
24.	Project X General Science (High School)	88	—0.162	Not significant at 5 % level
25.	Interview X Physics (High School)	220	—0.105	—do—
26.	Interview X Chemistry (High School)	220	—0.132	—do—
27.	Interview X Mathematics (High School)	218	—0.022	—do—
28.	Interview X Biology (High School)	64	—0.102	—do—
29.	Interview X General Science (High School)	88	0.113	—do—
30.	N.S.T.S. Total X Physics (H.S.)	221	0.002	—do—
31.	-do- X Chemistry (H.S.)	221	0.021	—do—
32.	-do- X Mathematics (H S.)	21✓	—0.182	—co—
33.	-do- X Biology (H.S.)	64	—0.106	—do—
34.	-do- X General Science (H.S.)	88	0.000	—do—
35.	Physics (High School) X Phy. (Hr. Sec.)	225	0.410	Significant at 1% level
36.	Chemistry (H.S.) X Chemistry (Hr. Sec.)	226	0.342	—do—
37.	Mathematics (H.S.) X Mathematics (Hr. Sec.)	215	0.281	Significant at 5% level
38.	Biology (H.S.) X Biology (Hr. Sec.)	56	0.117	Not Significant at 5% level
39.	Physics (Hr. Sec.) X Chemistry (Hr. Sec.)	234	0.484	Significant at 1% level
40	Physics (Hr. Sec.) X Mathematics (Hr. Sec.)	219	0.559	—do—
41.	Physics (Hr. Sec.) X Biology (Hr. Sec.)	83	0.339	—do—
42.	Physics (Hr. Sec.) X Total (Hr. Sec.)	157	0.623	—do—
43.	Chemistry (Hr. Sec.) X Mathematics (Hr. Sec.)	220	0.385	Significant at 5% level
44.	Chemistry (Hr. Sec.) X Biology (Hr. Sec.)	84	0.422	Significant at 1% level
45.	Chemistry (Hr. Sec.) X Total (Hr. Sec.)	157	0.411	—do—
46.	Mathematics (Hr. Sec.) Biology (Hr. Sec.)	69	0.154	Not significant at 1% level

Sr. No.	Specification	n	r	Significance Level
47.	Mathematics (Hr. Sec.) X Total (Hr. Sec.)	145	0.827	Significant at 1% level
48.	Biology (Hr. Sec.) X Total (Hr. Sec.)	64	0.286	Significant at 5% level
49	S.A.T. X Physics (Hr. Sec.)	226	0.296	—do—
50.	-do- X Chemistry (Hr. Sec.)	226	0.264	—do—
51.	-do- Mathematics (Hr. Sec.)	212	0.256	—do—
52.	-do- Biology (Hr. Sec.)	79	0 339	Significant at 1% level
53.	-do- X Total (Hr. Sec.)	156	0.271	Significant at 5% level
54.	Essay X Physics (Hr. Sec.)	226	0.093	Not significant at 5% level
55.	-do- X Chemistry (Hr. Sec.)	226	0 009	—do—
56.	-do- X Mathematics (Hr. Sec.)	212	—0.035	—do—
57.	-do- X Biology (Hr. Sec.)	79	0.015	—do—
58.	-do- X Total (Hr. Sec.)	156	0.024	—do—
59.	Project X Physics (Hr. Sec.)	226	0.019	—do—
60.	-do- X Chemistry (Hr. Sec.)	226	—0 082	—do—
61.	-do- X Mathematics (Hr. Sec.)	212	0.008	—do—
62.	-do- X Biology (Hr. Sec.)	79	—0.016	—do—
63.	-do- X Total (Hr. Sec.)	156	0.035	—do—
64.	Interview X Physics (Hr. Sec.)	226	—0.055	—do—
65.	-do- X (Hr. Sec.) Chemistry	226	—0.118	—do—
66.	-do- X Mathematics (Hr. Sec.)	212	—0.075	—do—
67.	-do- X Biology (Hr. Sec.)	79	—0.120	—do—
68.	-do- X Total (Hr. Sec.)	156	—0.061	—do—
69.	S.T.S. Total X Physics (Hr. Sec.)	227	0.069	—do—
70.	-do- X Chemistry (Hr. Sec.)	227	0.103	—do—
71.	S.T S. Total X Mathematics (Hr. Sec.)	213	0 056	—do—
72.	S.T.S. Total X Biology (Hr Sec.)	79	0.274	Significant at 5% level
73.	-do- X Total (Hr. Sec.)	156	0.188	Not significant at 5% level
74.	General Science (H S) X Physics (Hr. Sec.)	88	0.414	Significant at 1 % level
75.	General Science X Chemistry (Hr. Sec.)	88	0.127	Not significant at 5% level
76.	General Science X Mathematics (Hr. Sec)	84	0.540	Significant at 1% level
77.	General Science X Total (Hr. Sec.)	67	0.658	Significant at 1% level

NOTE :—H.S. —High School.
Hr. Sec. :—Higher Secondary

APPENDIX XIV

(A) (I) ITEM-ANALYSIS DATA FOR THE DISCRIMINATIVE AND DIFFICULTY VALUES OF ITEMS OF SCIENCE APTITUDE TEST (COMPULSORY PART) 1967

Sample Size for top group =164
Sample Size for Bottom group=164

Item No.	Correct Items (top group)	Correct items (Bottom group)	Difficulty value of each Item	Discriminative value of each Item	Subject	Remarks
1.	146	42	55	48	Physics	Selected
2.	123	19	44.5	48	-do-	-do-
3.	124	63	53.5	25	-do-	-do-
4.	128	74	57.5	20	-do-	-do-
5.	84	35	42	20	-do-	-do-
6.	148	55	58	45	-do-	-do-
7.	153	43	58	54	-do-	-do-
8.	141	98	63	21	Chemistry	-do-
9.	149	83	61	32	-do-	-do-
10.	110	64	52	18	-do-	-do-
11.	120	47	50	28	-do-	-do-
12.	151	80	62	36	-do-	-do-
13.	47	38	36	5	-do-	Rejected
14.	121	58	52	25	-do-	Selected
15.	138	54	55	36	Biology	-do-
16.	153	64	60	45	-do-	-do-
17.	142	40	53	46	-do-	-do-
18.	151	94	65	31	-do-	-do-
19.	124	52	52	28	-do-	-do-
20.	128	45	52	34	-do-	-do-
21.	62	13	29	45	-do-	-do-
22.	72	48	43	10	-do-	Rejected
23.	99	63	49	13	-do-	-do-
24.	137	95	61	20	Math.	Selected
25.	71	53	43	7	-do-	Rejected
26.	99	46	46	20	-do-	Selected
27.	42	30	33.5	7	-do-	Rejected
28.	63	49	42	6	-do-	-do-
29.	143	83	61	29	-do-	Selected
30.	112	40	48	29	-do-	-do-
31.	124	51	52	29	Agriculture	-do-
32.	161	89	67	45	-do-	-do-
33.	112	65	52	18	-do-	-do-
34.	103	43	46	23	-do-	-do-

35.	112	67	52	17	Agriculture	Rejected
36.	153	63	60	45	Geology	Selected
37.	153	72	61	40	-do-	-do-
38.	140	45	54	42	-do-	-do-
39.	138	79	59	26	-do-	-do-
40.	154	67	61	45	-do-	-do-
41.	153	78	62	40	Philosophy of Science	-do-
42.	161	65	63	55	do-	-do-
43.	117	31	47	35	-do-	-do-
44.	114	36	48	30	-do-	-do-
45.	122	41	50	32	-do-	-do-
46.	129	39	51	37	Physiology & Hygiene	-do-
47.	150	35	55	55	-do-	-do-
48.	124	45	31	50	-do-	-do-
49.	131	23	48	48	-do-	-do-
50.	100	42	46	23	-do-	-do-
51.	79	39	42	16	Engineering	Rejected
52.	148	26	52	56	-do-	Selected
53.	86	32	42	23	-do-	-do-
54.	122	37	49	35	-do-	-do-
55.	135	62	55	30	-do-	-do-
56.	99	25	42	32	Meteorology	-do-
57.	160	41	59	61	-do-	-do-
58.	132	55	54	32	-do-	-do-
59.	115	59	51	20	do-	-do-
60.	35	48	—	—	-do-	Rejected
61.	122	69	54	20	Bio-Chemistry	Selected
62.	103	83	53	8	-do-	Rejected
63.	151	82	62	35	-do-	Selected
64.	145	60	58	39	-do-	-do-
65.	136	46	55	45	-do-	-do-
66.	138	28	50	49	Astronomy	-do-
67.	140	39	53	45	-do	-do-
68.	93	57	48	13	-do-	Rejected
69.	35	14	26	16	-do-	-do-
70.	41	30	33	7	-do-	-do-
71.	89	38	43	20	Bio-Physics	Selected
72.	106	26	43	34	do-	-do-
73.	110	37	47	29	-do-	-do-
74.	61	33	38.5	13	-do-	Rejected
75.	70	23	38	20	-do-	Selected

Selected Items :—61 (81%)
Rejected Items :—14 (19%)

APPENDIX XIV (Contd.)

(II) ITEM ANALYSIS DATA FOR THE DISCRIMINATIVE AND DIFFICULTY VALUES OF ITEMS OF THE OPTIONAL PART (PHYSICS) OF THE SCIENCE APTITUDE TEST, YEAR 1967

Sample size for top Group=50 (27% of the stratified proportional sample of the examinees who attempted Physics as the optional part).

Sample size for Bottom Group=50 (27% of the stratified proportional sample of the examinees who attempted Physics as the optional part)

Item No.	Correct Item (top Group)	Correct Item (Bottom Group)	% age T.G.	% age B.G.	Difficulty value of each Item	Discriminative value of each Item	Result
1.	50	30	100	60	65	60	Selected
2.	49	27	98	54	67	45	-do-
3.	48	28	96	56	66	40	-do-
4.	48	25	96	50	64	44	-do-
5.	48	25	96	50	64	44	-do-
6.	43	23	86	46	59	30	-do-
7.	36	13	72	26	50	30	-do-
8.	23	14	46	28	43	12	-do-
9.	40	32	80	64	62	13	-do-
10.	14	7	28	14	23	11	-do-
11.	39	10	78	20	49	40	Selected
12.	6	8	12	16	—	—	Rejected
13.	30	12	60	24	45	23	Selected
14.	20	19	40	38	44	2	Rejected
15.	33	9	66	18	45	33	Selected
16.	12	16	24	32	—	—	Rejected
17.	47	36	94	72	71	25	-do-
18.	24	7	48	14	39	25	Selected
19.	39	12	78	24	50	37	-do-
20.	50	39	100	78	80	40	Rejected
21.	26	15	52	30	45	14	-do-
22.	14	6	28	12	32	16	-do-
23.	24	7	48	14	39	25	Selected
24.	17	16	34	32	41	2	Rejected
25.	25	10	50	20	42	20	Selected
26.	15	9	30	18	35	10	Rejected
27.	20	7	40	14	37	21	Selected
28.	20	6	40	12	36	23	-do-
29.	19	3	38	6	33	32	-do-
30.	45	22	90	44	60	36	-do
31.	41	9	82	18	50	45	-do-

32.	31	7	62	14	42	35	Selected
33.	34	2	68	4	39	54	-do-
34.	34	7	68	14	44	39	-do-
35.	31	8	62	16	43	32	-do-
36.	26	4	52	8	37	35	-do-
37.	25	8	50	16	40	25	-do-
38.	22	14	44	28	43	10	Rejected
39.	18	11	36	22	39	22	Selected
40.	27	23	54	46	50	5	Rejected
41.	26	16	52	32	46	12	-do-
42.	19	18	38	36	43	2	-do-
43.	29	8	58	16	42	30	Selected
44.	27	11	54	22	43	21	-do-
45.	35	19	70	38	52	20	-do-
46.	34	7	68	14	44	39	-do-
47.	34	16	68	32	50	22	-do-
48.	42	22	84	44	58	28	-do-
49.	34	8	68	16	45	36	-do-
50.	30	11	60	22	44	25	-do-

Item Selected 37 (74%)

Item Rejected 13 (26%)

Rejection region (i) Discriminative value less than 18

(ii) Difficulty value greater than 67.

(iii) ITEM ANALYSIS DATA FOR THE DISCRIMINATIVE AND DIFFICULTY VALUES OF ITEMS OF THE OPTIONAL PART (CHEMISTRY) OF THE SCIENCE APTITUDE TEST 1967

Sample size of top group=54 (27% of the stratified proportional sample of the examinees who choose chemistry as the optional part)

Sample size of Bottom Group=54 (27% of stratified proportional sample of the examinees who choose chemistry as the optional part)

Remarks

Item No.	correct Items Top group	correct Item Bottom group	%age T.G.	%age B.G.	Difficulty value of each Item	Discriminative value of each Item	Result
1.	53	31	98.0	57.3	69	45	Rejected
2.	16	16	29.6	29.6	—	—	-do-
3.	30	7	55.5	13.0	42.0	31	Selected
4.	26	25	48.0	46.2	49	0	Rejected
5.	48	24	88.8	44.4	60	34.5	Selected
6.	30	16	55.5	29.6	46	16.5	Rejected
7.	48	19	88.8	35.1	58	40	Selected
8.	49	16	90.6	29.6	58	48	-do-
9.	49	32	90.6	59.2	64	27	-do-
10.	40	13	74.0	24.0	50	33	-do-
11.	33	9	61.0	16.6	43	30	-do-
12.	49	26	90.6	48.1	61	35	-do-
13.	50	17	92.5	31.4	59	50	-do-
14.	26	10	48.1	18.5	40	20.5	-do-
15.	42	20	77.7	37.0	54	27	-do-
16.	20	8	37.0	14.8	36	18.5	-do-
17.	49	25	90.6	46.2	61	36	-do-
18.	48	24	88.8	44.4	60	34.5	-do-
19.	28	10	51.8	18.5	41	23	-do-
20.	48	21	88.8	38.8	59	37	-do-
21.	34	16	63.0	29.6	48	20	-do-
22.	46	15	85.1	27.7	54	40	-do-
23.	43	15	79.5	27.7	52	35	-do-
24.	22	11	40.7	20.3	39	15	Rejected
25.	36	16	66.6	29.6	49	23.5	Selected
26.	25	17	46.2	31.4	43	10	Rejected
27.	31	13	57.3	24.0	45	21	Selected
28.	33	15	61.0	27.7	47	20	-do-
29.	47	27	87.0	50.0	60	28.6	-do-
30.	49	28	90.6	51.8	62	32.5	-do-

31.	50	27	92.5	50·0	63	36.5	Selected
32.	50	33	92.5	61.0	66	30	-do-
33.	50	28	92.5	51.8	63	35	-do-
34.	23	21	42.5	38.8	45	3	Rejected
35.	44	24	81.4	44.4	57	26	Selected
36.	51	17	94.3	31.4	59	52	-do-
37.	39	10	72.1	18.5	47	36.5	-do-
38.	40	25	74.0	46.2	55	18	-do-
39.	32	3	59.2	5 5	38	45	-do-
40.	19	14	35.1	25.9	39	7	Rejected
41.	43	11	79.5	20.3	51	39	Selected
42.	47	14	86.9	25.9	55	45	-do-
43.	47	14	86.9	25.9	55	45	-do-
44.	46	7	85.1	12 9	50	53	-do-
45.	49	12	90.6	22.2	55	53	-do-
46.	37	19	68.4	35.1	51	20	-do-
47.	15	14	27.7	25.9	37	2	Rejected
48.	41	34	75.8	62.9	61	10	-do-
49.	49	26	90.6	48.1	61	35	Selected
50.	49	28	90.6	51.8	62	32	-do-

Items Rejected.. 10 (20%)

Items Selected.. 40 (80%)

Rejection Region (i) Discriminative value less than 18

(ii) Difficulty value greater than 67

APPENDIX XIV (Contd.)

(iv) ITEM ANALYSIS DATA FOR THE DISCRIMINATIVE AND DIFFICULTY VALUES OF ITEMS OF THE OPTIONAL PART (BIOLOGY) OF THE SCIENCE APTITUDE TEST, YEAR 1967

Sample size of the Top Group=50 (27% of the stratified proportional sample of the students who choose Biology as the optional part)

Sample size of the Bottom Group=50 (27% of the stratified proportional sample of the students who choose Biology as the optional part)

S. No.	Correct Items Top Group	Correct Items Bottom Group	% age T.G.	% age B.G.	Difficulty value of each Item	Discriminative value of each Item	Remarks
1.	44	37	88	74	69	15	Rejected
2.	50	39	100	78	79	40	-do-
3.	43	10	86	20	52	48	Selected
4.	9	5	18	10	26	10	Rejected
5.	32	33	64	66	—	—	Rejected
6.	46	10	92	20	55	56	Selected
7.	29	18	58	36	48	14	Rejected
8.	46	19	92	38	59	45	Selected
9.	45	16	90	32	58	45	-do-
10.	49	36	98	72	75	35	Rejected
11.	49	28	98	56	68	45	-do-
12.	44	13	88	26	55	47	Selected
13.	49	35	98	70	73	35	Rejected
14.	49	32	98	64	71	40	-do-
15.	36	9	72	18	46	37	Selected
16.	21	9	42	18	39	18	-do-
17.	39	19	78	38	54	27	-do-
18.	37	20	74	40	54	22	-do-
19.	48	31	96	62	69	35	Rejected
20.	46	16	92	32	59	49	Selected
21.	48	21	96	42	62	50	-do-
22.	50	41	100	82	82	40	Rejected
23.	48	21	96	42	62	50	Selected
24.	30	9	60	18	43	29	-do-
25.	26	9	52	18	42	24	-do-
26.	39	11	78	22	50	38	-do-
27.	37	20	74	40	55	25	-do-
28.	38	8	76	16	47	43	-do-
29.	44	31	88	62	65	23	-do-
30.	30	16	60	32	48	17	Rejected
31.	45	25	90	50	61	32	Selected
32.	40	17	80	34	54	30	-do-

33.	48	19	96	38	61	50	-do-
34.	50	29	100	58	71	50	Rejected
35.	47	25	94	50	63	40	Selected
36.	50	34	100	68	75	46	Rejected
37.	50	35	100	70	76	46	-do-
38.	50	38	100	76	77	40	Rejected
39.	50	28	100	56	70	50	-do-
40.	33	22	66	44	52	14	-do-
41.	40	19	80	38	55	28	Selected
42.	21	14	42	28	42	10	Rejected
43.	28	18	56	36	48	12	-do-
44.	39	7	78	14	47	47	Selected
45.	40	23	80	46	57	24	-do-
46.	44	19	88	38	58	37	-do-
47.	44	14	88	28	55	45	-do-
48.	37	15	74	30	51	28	-do-
49.	19	7	38	14	36	20	-do-
50.	45	21	90	42	59	37	-do-

Rejection region (i) Discriminative value less than 18.

(ii) Difficulty value greater than 67

Items Selected : 30 (60%)

Items Rejected : 20 (40%)

APPENDIX XIV (Contd.)

(v) ITEM-ANALYSIS DATA FOR THE DISCRIMINATIVE AND DIFFICULTY VALUES OF ITEMS OF THE OPTIONAL PART (MATHEMATICS) OF THE SCIENCE APTITUDE TEST, 1967

Sample Size For the Top Group=100
Sample Size For the Bottom Group=100

Item No	Correct Items (top Group)	Correct Items (Bottom group)	Discriminative value of each Item	Difficulty value of each Item	Remarks
1.	46	11	29	37	Selected
2.	34	24	7	39	Rejected
3.	50	16	25	40	Selected
4.	11	16	—	—	Rejected
5.	47	21	18	41	Selected
6.	21	6	20	25	do
7.	57	28	18	46	do
8.	50	21	20	42	do
9.	32	15	15	34	Rejected
10.	16	15	0	30	do
11.	60	40	12	50	do
12.	64	21	29	45	Selected
13.	59	35	15	49	Rejected
14.	62	21	27	45	Selected
15.	52	24	18	43	do
16.	67	26	26	48	do
17.	72	52	14	56	Rejected
18.	37	37	0	43	do
19.	64	38	15.5	50.5	do
20.	21	8	17.5	26	do
21.	88	44	34	59.5	Selected
22.	97	64	37	70	do
23.	30	18	10	35	Rejected
24.	47	9	32.5	36	Selected
25.	62	18	30	43.5	do
26.	59	15	31.5	42	do
27.	73	38	22	53	do
28.	35	12	20	34	do
29.	79	44	24	56.5	do
30.	70	41	18	53	do
31.	53	23	20	43	do
32.	62	12	37.5	41	do
33.	44	18	19.5	39	do

34.	50	12	30	38.5	Selected
35.	44	15	22.5	38	do
36.	62	38	15	50	Rejected
37.	37	20	13	38	do
38.	56	15	30	41	Selected
39.	67	18	34	45	do
40.	62	26	23	46.5	do
41.	41	15	20.5	37	do
42.	23	3	29.5	24.5	do
43.	29	15	13.5	33.5	Rejected
44.	0	8	—	—	do
45.	35	18	13.5	36.5	do
46.	29	15	13.5	33.5	do
47.	10	16	—	—	do
48.	41	26	10	41	do
49.	65	18	32	45	Selected
50.	50	20	21	42	do

Items Selected :—31 (62%)

Items Rejected :—19 (38%)

(B) AN ANALYSIS OF THE ITEMS SELECTED AND REJECTED ON THE BASIS OF DISCRIMINATIVE AND DIFFICULTY VALUES

COMPULSORY PART

Areas	Thought type Items		
	Items Rejected		Items Selected
Physics	0	+	7
Chemistry	1	+	6
Biology	2	+	7
Mathematics	3	+	4
Agriculture	1	+	4
Geology	0	+	5
Philosophy of Science	0	+	5
Physiology & Hygiene	0	+	5
Engineering	1	+	4
Meteorology	1	+	4
Bio-chemistry	1	+	4
Astronomy	3	+	2
Bio-Physics	1	+	4
	14	+	61
	19%		81%

OPTIONAL PART OF THE TEST

Areas	Factual type Items			Thought type Items			Total		
	Items rejected		Items selected	Items rejected		Items selected	Items rejected		Items selected
1. Physics	9	+	21=(30)	4	+	16=(20)	13	+	37=(50)
2. Chemistry	6	+	24=(30)	4	+	16=(20)	10	+	40=(50)
3. Biology	12	+	18=(30)	8	+	12=(20)	20	+	30=(50)
(i) Botany	9	+	6=(15)	6	+	4=(10)	15	+	10=(25)
(ii) Zoology	3	+	12=(15)	2	+	8=(10)	5	+	20=(25)
4. Mathematics	11	+	19=(30)	8	+	12=(20)	19	+	31=(50)
	38	+	82	24	+	56	62	+	138
	32%		68%	30%		70%	31%		69%
Total		(120)			(80)			(200)	

Items rejected :— 27.6%
Items selected :— 72.4%

APPENDIX XV

Sample Size=600 (10% of population)

(A) DATA FOR THE RELIABILTY OF THE COMPULSORY PART OF THE SCIENCE APTITUDE TEST 1967

Sl. No.	No. of students passing at the item	No. of students failing at the item	p—propotion passing at the item	q—proportion failing at the item
1.	305	295	.5083	.4917
2.	217	383	.3616	.6384
3.	331	269	.5516	.4484
4.	358	242	.5966	.4034
5.	225	375	.3749	.6251
6.	394	206	.6566	.3434
7.	377	223	.6283	.3717
8.	442	158	.7367	.2633
9.	416	184	.6933	.3067
10.	330	270	.5499	.4501
11.	299	301	.4983	.5017
12.	415	185	.6916	.3084
13.	141	459	.2349	.7651
14.	300	300	.5000	.5000
15.	377	223	.6283	.3717
16.	409	191	.6816	.3184
17.	328	272	.5466	.4534
18.	463	137	.7717	.2283
19.	326	274	.5433	.4567
20.	317	283	.5282	.4717
21.	120	480	.1999	.8001
22.	224	376	.3732	.6268
23.	287	313	.4783	.5217
24.	436	164	.7267	.2733
25.	220	380	.3666	.6334
26.	244	356	.4066	.5934
27.	105	495	.1749	.8251
28.	190	410	.3166	.6834
29.	526	74	.8767	.1233
30.	266	334	.4433	.5567
31.	316	284	.5266	.4734
32.	496	104	.8267	.1733
33.	332	268	.5533	.4467
34.	251	349	.4182	.5818
35.	327	273	.5450	.4550

36.	404	196	.6733	.3267
37.	426	174	.7100	.2900
38.	357	243	.5949	.4051
39.	470	130	.7833	.2167
40.	435	165	.7250	.2750
41.	447	153	.7450	.2550
42.	448	152	.7467	.2533
43.	264	336	.4399	.5601
44.	263	337	.4383	.5617
45.	282	318	.4699	.5301
46.	299	301	.4983	.5017
47.	321	279	.5349	.4651
48.	299	301	.4983	.5017
49.	253	347	.4216	.5784
50.	277	323	.4616	.5384
51.	206	394	.3432	.6568
52.	318	282	.5299	.4701
53.	263	337	.4383	.5617
54.	264	336	.4399	.5601
55.	363	237	.6050	.3950
56.	209	391	.3482	.6518
57.	374	226	.6233	.3767
58.	351	249	.5850	.4150
59.	373	227	.6216	.3784
60.	163	437	.2716	.7284
61.	343	257	.5716	.4284
62.	472	128	.7867	.2133
63.	443	157	.7383	.2617
64.	365	235	.6083	.3917
65.	384	216	.6400	.3600
66.	285	315	.4749	.5251
67.	309	291	.5149	.4851
68.	353	247	.5883	.4117
69.	76	524	.1265	.8735
70.	126	474	.2099	.7901
71.	237	363	.3949	.6051
72.	218	382	.3632	.6368
73.	240	360	.4000	.6000
74.	159	441	.2649	.7351
75.	145	455	.8242	.1758

$\Sigma pq = 16.687$

$$r = \frac{n}{n-1} \quad \frac{(Sdt^2 - \Sigma pq)}{Sdt^2}$$

$Sdt^2 = 186.077$

n = number of items in the test.

$r_{11} = 0.92$

Class Interval of Test scores

Class Intervals	Frequency
0-4	1
5-9	5
10-14	9

Class Intervals	Frequency
15-19	22
20-24	64
25-29	61
30-34	72
35-39	86
40-44	70
45-49	60
50-54	69
55-59	36
60-64	27
65-69	16
70-74	2
	N - 600

APPENDIX XV (Contd.)

Sample Size=189

(B) DATA FOR THE RELIABILITY OF THE OPTIONAL PART (PHYSICS) OF THE SCIENCE APTITUDE TEST—1967

S. No.	No. of Students passing at the item	No. of Students failing at the item.	P=proportion passing at the item	q=proportion failing at the item
1.	168	21	.8889	.1111
2.	157	32	.8306	.1693
3.	170	19	.8995	.1005
4.	148	41	.7831	.2169
5.	149	40	.7884	.2116
6.	126	63	.6667	.3333
7.	67	122	.3545	.6455
8.	64	125	.3386	.6614
9.	141	48	.7461	.2539
10.	33	156	.1746	.8254
11.	90	99	.4762	.5238
12.	28	161	.1482	.8518
13.	80	109	.4233	.5767
14.	67	113	.4021	.5979
15.	72	117	.3810	.6190
16.	49	140	.2593	.7407
17.	157	32	.8306	.1693
18.	44	145	.2328	.7672
19.	97	92	.5132	.4868
20.	165	24	.8730	.1270
21.	67	122	.3545	.6455
22.	30	159	.1588	.8412
23.	52	137	.2752	.7248
24.	63	126	.3333	.6667
25.	58	131	.3069	.6931
26.	29	160	.1535	.8465
27.	55	134	.2910	.7090
28.	39	150	.2064	.7936
29.	27	162	.1429	.8571
30.	138	51	.7302	.2698
31.	95	94	.5027	.4973
32.	66	123	.3492	.6508
33.	56	133	.2963	.7037
34.	70	119	.3704	.6296
35.	60	129	.3175	.6825
36.	40	149	.2117	.7883

37.	51	138	.2699	.7301
38.	61	128	.3228	.6772
39.	48	141	.2540	.7460
40.	80	109	.4233	.5767
41.	76	113	.4021	.5979
42.	69	120	.3651	.6349
43.	63	126	.3333	.6667
44.	64	125	.3387	.6613
45.	99	90	.5238	.4762
46.	66	123	.3491	.6508
47.	85	104	.4498	.5502
48.	113	76	.5979	.4021
49.	72	117	.3810	.6190
50.	76	113	.4021	.5979
				$\Sigma pq = 9.9702$

$Sdt^2 = 61.425$

$r_{11} = .86$

Class Intervals of Test Scores

Class Intervals	Frequency
0-4	—
5-9	5
10-14	21
15-19	61
20-24	52
25-29	24
30-34	13
35-39	5
40-44	5
45-49	3
	N = 189

APPENDIX XV (Contd.)

Sample Size=194

DATA FOR THE RELIABILITY OF THE OPTIONAL PART (CHEMISTRY) OF THE SCIENCE APTITUDE TEST—1967

S. No.	No. of students passing at the item	No. of students failing at the item	P=proportion passing at the item	q=proportion failing at the item
1.	155	39	.7988	.2012
2.	47	147	.2424	.7576
3.	58	136	.2990	.7010
4.	100	94	.5154	.4846
5.	115	79	.5928	.4072
6.	76	118	.3918	.6082
7.	107	87	.5516	.4484
8.	127	67	.6546	.3453
9.	149	45	.7681	.2319
10.	100	94	.5155	.4845
11.	77	117	.3970	.6030
12.	143	51	.7371	.2629
13.	118	76	.6083	.3917
14.	52	142	.1681	.7319
15.	121	73	.6238	.3762
16.	54	140	.2784	.7216
17.	131	63	.6753	.3247
18.	132	62	.6805	.3195
19.	64	130	.3300	.6700
20.	117	77	.6032	.3968
21.	84	110	.4331	.5669
22.	107	87	.5516	.4484
23.	111	83	.5722	.4278
24.	63	131	.3249	.6751
25.	78	116	.4022	.5978
26.	73	121	.3764	.6236
27.	67	127	.3454	.6546
28.	71	123	.3661	.6339
29.	123	71	.6341	.3659
30.	146	48	.3867	.6133
31.	154	40	.7939	.2061
32.	167	27	.8609	.1391
33.	147	47	.7578	.2422
34.	85	109	.4382	.5618
35.	119	75	.6135	.3865
36.	125	69	.6444	.3556
37.	85	109	.4382	.5618
38.	109	85	.5619	.4381

39.	56	138	.2888	.7112
40.	64	130	.3300	.6700
41.	90	104	.4640	.5360
42.	111	83	.5722	.4278
43.	111	83	.5722	.4278
44.	91	103	.4692	.5308
45.	114	80	.5877	.4123
46.	92	102	.4743	.5257
47.	46	148	.2372	.7628
48.	127	67	.6547	.3453
49.	134	60	.6908	.3092
50.	137	57	.7062	.2[illegible]38

$\Sigma pq = 11.0986$

$Sdt^2 = 83.475$

$r_{11} = .88$

Class Intervals of Test Scores

Class Intervals	Frequency
0-4	—
5-9	3
10-14	16
15-19	30
20-24	31
25-29	37
30-34	39
35-39	22
40-44	11
45-49	5
	N. 194

Sample Size=140

DATA FOR THE RELIABILITY OF THE OPTIONAL PART (BIOLOGY) OF THE SCIENCE APTITUDE TEST—1967

S. No.	No. of students passing at the item	No. of students failing at the item	p=proportion passing at the item	q=proportion failing at the item
1.	112	28	.8000	.2000
2.	123	17	.8786	.1214
3.	65	75	.4644	.5356
4.	21	119	.1501	.8499
5.	93	47	.6644	.3356
6.	71	69	.5072	.4928
7.	80	60	.5715	.4285
8.	84	56	.6000	.4000
9.	74	66	.5287	.4713
10.	123	17	.8786	.1214
11.	104	36	.7429	.2571
12.	78	62	.5572	.4428
13.	125	15	.8929	.1071
14.	105	35	.7500	.2500
15.	60	80	.4287	.5713
16.	44	96	.3144	.6856
17.	77	63	.5501	.4499
18.	74	66	.5287	.4713
19.	115	25	.8215	.1785
20.	84	56	.6000	.4000
21.	86	54	.6144	.3856
22.	127	13	.9072	.0928
23.	91	49	.6501	.3499
24.	47	93	.3358	.6642
25.	39	101	.2787	.7213
26.	55	85	.3930	.6070
27.	77	63	.5501	.4499
28.	62	78	.4430	.5570
29.	95	45	.6787	.3213
30.	64	76	.4572	.5428
31.	98	42	.7001	.2999
32.	72	68	.5144	.4856
33.	90	50	.6429	.3571
34.	106	34	.7572	.2428
35.	95	45	.6787	.3213
36.	123	17	.8786	.1214
37.	121	19	.8643	.1357

38.	125	15	.8929	.1071
39.	108	32	.7715	.2285
40.	77	63	.5501	.4499
41.	80	60	.5715	.4285
42.	57	83	.4073	.5927
43.	65	75	.4644	.5356
44.	52	88	.3715	.6285
45.	71	69	.5072	.4928
46.	80	60	.5715	.4285
47.	81	59	.5787	.4213
48.	52	88	.3715	.6285
49.	39	101	.2787	.7213
50.	94	46	.6715	.3285

$\Sigma\ pq = 10.3900$

$Sdt^2 = 79.4225$

$r_{11} = .89$

Class Intervals of Test Scores

Class Interval	Frequency
0-4	0
5-9	1
10-14	5
15-19	9
20-24	27
25-29	28
30-34	32
35-39	15
40-44	14
45-49	9
	N -140

Sample Size=149

DATA FOR THE RELIABILITY OF THE OPTIONAL PART (MATHEMATICS) OF THE SCIENCE APTITUDE TEST—1967

S. No.	No. of students passing at the Items	No. of students failing at the Item	p=proportion passing at the Item	q=proportion failing at the Item
1.	28	121	.1880	.8120
2.	101	48	.6779	.3221
3.	32	117	.2148	.7852
4.	38	111	.2551	.7449
5.	21	128	.1410	.8590
6.	59	90	.3960	.6040
7.	38	111	.2551	.7449
8.	29	120	.1947	.8053
9.	40	109	.2085	.7315
10.	16	133	.1075	.8925
11.	57	92	.3826	.6174
12.	45	104	.3021	.6979
13.	66	83	.4430	.5570
14.	49	100	.3289	.6711
15.	86	63	.5772	.4228
16.	16	133	.1075	.8925
17.	32	117	.2158	.7852
18.	49	100	.3289	.6711
19.	28	121	.1880	.8120
20.	54	95	.3625	.6375
21.	54	95	.3625	.6375
22.	90	59	.6041	.3959
23.	14	135	.0940	.9060
24.	77	72	.5168	.4832
25.	91	58	.6108	.3892
26.	68	81	.4564	.5436
27.	33	116	.2216	.7784
28.	51	98	.3423	.6577
29.	26	123	.1746	.8254
30.	31	118	.2081	.7919
31.	61	88	.4095	.5905
32.	64	85	.4296	.5704
33.	54	95	.3625	.6375
34.	50	99	.3356	.6644
35.	35	114	.2350	.7650
36.	31	118	.2081	.7919

37.	41	108	.2752	.7248
38.	32	117	.2146	.7852
39.	35	114	.2350	.7650
40.	39	110	.2618	.7382
41.	32	117	.2148	.7852
42.	19	130	.1276	.8724
43.	34	115	.2283	.7717
44.	33	116	.2216	.7784
45.	39	110	.2618	.7382
46.	25	124	.1679	.8321
47.	42	107	.2820	.7180
48.	27	122	.1813	.8187
49.	18	131	.1209	.8791
50.	40	109	.2685	.7315

$\Sigma pq = 10.6413$

$Sdt^2 - 36.4850$

$r_{11} - .72$

Class Intervals of Test Scores

Class Interval	Frequency
0-4	5
5-9	15
10-14	56
15-19	55
20-24	15
25-29	2
30-34	3
	N . 149

APPENDIX XVI (A)

FIGURES AT A GLANCE

(i) Sample size=(Sample of selected awardees)—

	Science Aptitude Test	Essay	Interview	Project Report	N.S.T.S. Total
Science Aptitude Test	—	—0.160	—0.234*	—0.041	0.335*
Essay	—0.160	—	—0.166	—0.088	0.134
Interview	—0 234	—6 166	—	—0.072	0.084
Project Report	—0.041	—0 088	—0.072	—	0.180
N.S.T.S. total	0.335*	0.134	0.084	—0.180	—

(ii) Sample size=(approximately 7 % of the candidates who took the N.S.T.S. Examination year 1967)

Science Aptitude Test	—	0.32*	0.20*	0.37*	0.93**
Essay	0.32*	—	0.10	0.17*	0.53**
Interview	0.20*	0.10	—	0.15	0.69**
Project Report	0.37*	0.17*	0.15	—	0.49**
N.S.T.S. Total	0.93*	0.53**	0.69**	0.49**	—

* :—Significant at 5% level

** :—highly significant.

APPENDIX XVI (B)
Table 1

THE DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED IN S.A.T. & ESSAY PAPER BY THE EXAMINEES OF THE N.S.T.S. EXAMINATION YEAR 1967.

Marks scored in Essay/Marks scored in S.A.T.	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	Total
0-9	1	6	4	19	9	5	2	—	—	46
10-19	9	9	7	18	10	8	3	1	—	64
20-29	4	8	9	10	20	13	3	1	—	68
30-39	6	8	6	15	11	9	4	—	—	59
40-49	1	4	7	11	8	20	4	1	1	57
50-59	—	—	10	6	8	16	3	—	—	43
60-69	1	1	1	6	10	8	3	4	—	34
70-79	—	3	3	7	4	7	1	2	—	27
80-89	1	—	1	—	5	10	1	1	—	19
90-99	—	—	2	—	—	3	4	1	—	10
100-109	—	—	—	1	—	—	4	1	—	6
110-119	—	—	—	—	—	2	—	—	—	2
Total	23	38	50	93	85	101	32	12	1	435

(i) Average score scored by the examinee in S. A. T.=39.83 (ii) S.D. =25.4

(iii) —do— in Essay paper=20.77 (iv) S.D. =8.56

r=0.321

The value of r is significant at 1 % level.

Table 2

THE DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED IN S.A.T. & PROJECT REPORT BY THE EXAMINEES OF THE N.S.T.S. EXAMINATION YEAR 1967.

Marks scored in Project Report/ S.A.T.	0-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	Total
0-9	—	8	6	7	11	8	3	3	—	—	—	46
10-19	5	6	9	14	12	9	8	—	—	1	—	64
20-29	4	3	12	10	20	10	7	1	1	—	—	68
30-39	10	3	8	7	9	10	5	6	1	—	—	59
40-49	—	4	7	8	11	8	7	6	3	2	1	57
50-59	1	1	6	3	9	7	4	6	3	2	1	43
60-69	2	—	1	5	4	5	8	5	4	—	—	34
70-79	—	—	1	1	2	5	8	3	3	2	2	27
80-89	—	—	1	—	5	5	2	4	—	2	—	19
90-99	—	—	—	2	2	3	—	1	—	1	1	10
100-109	—	—	1	1	—	—	1	2	—	—	1	6
110-119	—	—	—	—	1	—	—	—	1	—	—	2
Total	22	25	52	58	86	70	53	37	16	10	6	435

(i) Average score scored by the examinee in S.A.T. =39.83 (ii) S.D. =25.4

(iii) —do— Project Report=10.01 (iv) S.D. =4.44

r =0.37

The value of r is significant at 1 % level.

APPENDIX XVI (B)

Table 1

THE DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED IN S.A.T. & ESSAY PAPER BY THE EXAMINEES OF THE N.S.T.S. EXAMINATION YEAR 1967.

Marks scored in Essay/Marks scored in S.A.T.	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	Total
0-9	1	6	4	19	9	5	2	—	—	46
10-19	9	9	7	18	13	8	3	1	—	64
20-29	4	8	9	10	20	13	3	1	—	68
30-39	6	8	6	15	11	9	4	—	—	59
40-49	1	4	7	11	8	20	4	1	1	57
50-59	—	—	10	6	8	16	3	—	—	43
60-69	1	1	1	6	10	8	3	4	—	34
70-79	—	3	3	7	4	7	1	2	—	27
80-89	1	—	1	—	5	10	1	1	—	19
90-99	—	—	2	—	—	3	4	1	—	10
100-109	—	—	—	1	—	—	4	1	—	6
110-119	—	—	—	—	—	2	—	—	—	2
Total	23	38	50	93	85	101	32	12	1	435

(i) Average score scored by the examinee in S. A. T.=39.83 (ii) S.D. =25.4

(iii) —do— in Essay paper=20.77 (iv) S.D. =8.56

r=0.321

The value of r is significant at 1 % level.

Table 2

THE DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED IN S.A.T. & PROJECT REPORT BY THE EXAMINEES OF THE N.S.T.S. EXAMINATION YEAR 1967.

Marks scored in Project Report/ S.A.T.	0-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	Total
0-9	—	8	6	7	11	8	3	3	—	—	—	46
10-19	5	6	9	14	12	9	8	—	—	1	—	64
20-29	4	3	12	10	20	10	7	1	1	—	—	68
30-39	10	3	8	7	9	10	5	6	1	—	—	59
40-49	—	4	7	8	11	8	7	6	3	2	1	57
50-59	1	1	6	3	9	7	4	6	3	2	1	43
60-69	2	—	1	5	4	5	8	5	4	—	—	34
70-79	—	—	1	1	2	5	8	3	3	2	2	27
80-89	—	—	1	—	5	5	2	4	—	2	—	19
90-99	—	—	—	2	2	3	—	1	—	1	1	10
100-109	—	—	1	1	—	—	1	2	—	—	1	6
110-119	—	—	—	—	1	—	—	—	1	—	—	2
Total	22	25	52	58	86	70	53	37	16	10	6	435

(i) Average score scored by the examinee in S.A.T. =39.83 (ii) S.D. =25.4

(iii) —do— Project Report=10.01 (iv) S.D. =4.44

r =0.37

The value of r is significant at 1 % level.

Table 3

DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED IN S.A.T. & INTERVIEW TEST BY THE EXAMINEES OF THE N.S.T.S. EXAMINATION YEAR 1967.

Marks scored in interview/ S.A.T. Test	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	Total
0-9	—	—	—	—	—	—	—	—	—	—	—
10-19	—	—	—	—	—	—	—	—	—	—	—
20-29	—	—	—	—	—	—	—	—	—	—	—
30-39	—	—	—	—	—	—	—	—	—	—	—
40-49	—	—	—	1	—	—	—	—	—	—	1
50-59	1	1	1	—	—	—	—	—	—	—	3
60-69	4	6	3	3	3	1	—	—	1	—	21
70-79	3	8	7	2	2	2	—	—	—	—	24
80-89	1	3	3	3	4	2	1	1	—	—	18
90-99	—	2	2	—	1	1	1	—	—	1	8
100-109	—	—	2	—	2	2	—	—	—	—	6
110-119	—	—	—	2	—	—	—	—	—	—	2
Total	9	20	18	11	12	8	2	1	1	1	83

(i) Average score scored by the examinees in S. A. T.=78.11 (ii) S.D. =14.19

(iii) Average score scored by the examinees at Interview=15.85 (iv) S.D. =9.55

r=0.200

The value of r is significant at 5% Level.

Table 4

DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED IN S.A.T. & THE N.S.T.S. TOTAL OF THE EXAMINEES OF THE N.S.T.S. EXAMINATION, YEAR 1967.

N S.T.S. Total/S.A.T. Marks	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	Total
0-9	38	8	—	—	—	—	—	—	—	46
10-19	29	35	—	—	—	—	—	—	—	64
20-29	7	41	20	—	—	—	—	—	—	68
30-39	1	24	33	1	—	—	—	—	—	59
40-49	1	—	29	26	—	1	—	—	—	57
50-59	—	—	5	35	3	—	—	—	—	43
60-69	—	—	1	12	10	9	2	—	—	34
70-79	—	—	—	3	7	15	2	—	—	27
80-89	—	—	—	1	1	5	9	3	—	19
90-99	—	—	—	—	—	2	4	3	1	10
100-109	—	—	—	—	—	—	2	3	1	9
110-119	—	—	—	—	—	—	—	2	—	2
Total	76	108	88	78	21	32	19	11	2	435

(i) Average score scored by the examinees in S.A.T. =39.83 (ii) S.D. =25.42

(iii) Aggregate score scored by the examinees in N.S.T.S. Examination =74.55 (iv) S.D. =37.02

r=0.936

The value of r is highly significant

Table 5

THE DEGREE OF ASSOCIATION (CORRELATION) BETWEEN THE MARKS SCORED IN ESSAY AND PROJECT REPORT PAPERS BY THE EXAMINEES OF THE N.S.T.S. EXAMINATION YEAR 1967.

Marks scored in Project report/ Essay Paper	0-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	21-22	Total
0-5	2	2	1	4	8	5	—	1	—	—	—	23
6-10	5	2	4	7	10	4	3	2	1	—	—	38
11-15	1	2	7	6	9	11	7	4	2	1	—	50
16-20	5	7	13	17	14	15	8	11	1	1	1	93
21-25	4	4	10	6	18	16	14	7	3	3	—	85
26-30	4	7	14	11	17	12	17	8	5	5	1	101
31-35	1	1	2	6	6	3	3	4	3	—	3	32
36-40	—	—	1	1	4	4	—	—	1	—	1	12
41-45	—	—	—	—	—	—	1	—	—	—	—	1
Total	22	25	52	58	86	70	53	37	16	10	6	435

(i) Average score scored in the Essay paper = 20.77 (ii) S.D. = 8.56

(iii) —do— Project Report = 10.01 (iv) S.D. = 4.44

$r = 0.17$

The value of r is significant at 5% level.

Table 6

THE DEGREE OF ASSOCIATION (CORRELATION) BETWEEN THE MARKS SCORED BY THE EXAMINEES IN ESSAY PAPER AND THE TOTAL IN N.S.T.S. EXAMINATION, YEAR 1967.

Total N.S.T.S. score/Marks scored in Essay Paper	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	Total
0-5	13	8	—	2	—	—	—	—	—	23
6-10	20	9	5	4	—	—	—	—	—	38
11-15	10	16	13	5	3	2	1	—	—	50
16-20	23	30	18	15	2	4	1	—	—	93
21-25	7	25	22	17	5	7	1	1	—	85
26-30	3	12	25	28	8	12	9	4	—	101
31-35	—	7	4	6	1	4	3	5	2	32
36-40	—	1	1	1	2	3	3	1	—	12
41-45	—	—	—	—	—	—	1	—	—	1
Total	76	108	88	78	21	32	19	11	2	435

(i) Average score scored in Essay paper = 20.77
(ii) S.D. = 8.56
(iii) Average in N.S.T.S TOTAL = 74.55
(iv) S.D. = 37.02

r=0.53

The vlue of r is significant at 0.01 Leval.

Table 7

THE DEGREE OF ASSOCIATION (CORRELATION) BETWEEN THE MARKS SCORED IN ESSAY PAPER AND INTERVIEW BY THE EXAMINEES OF THE N.S.T.S. EXAMINATION, YEAR 1967.

Marks scored in Interview/Marks scored in Essay Paper	0-5	6-10	11-15	16-20	21-25	26-30	31 35	36-40	41-45	46-50	Total
0-5	—	—	—	—	—	—	—	—	—	—	—
6-10	—	—	—	—	—	—	—	—	—	—	—
11-15	1	2	—	—	2	—	—	—	—	—	5
16-20	—	2	2	—	2	1	—	—	—	—	7
21-25	4	4	3	1	1	1	—	1	—	—	15
26-30	3	9	6	7	3	3	1	—	1	—	33
31-35	1	—	4	2	2	2	1	—	—	1	13
36-40	—	4	3	—	1	—	—	—	—	—	8
41-45	—	—	—	1	1	—	—	—	—	—	2
Total	9	21	18	11	12	7	2	1	1	1	83

(i) Average score scored in Essay paper = 27.45

(ii) S.D. = 6.708

(iii) Average score scored in Interview = 15.59

(iv) S.D. = 9.500

r = 0.10

The value of r is not significant at 5% level

Table 8

THE DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED BY THE EXAMINEES IN INTERVIEW AND THEIR N.S.T.S. TOTAL EXAMINATION

N.S.T.S. Total/ Interview Marks	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	Total
0-5	—	—	—	—	9	—	—	—	—	9
5-10	—	—	—	—	4	3	1	—	—	8
10-15	—	—	—	—	8	9	5	—	—	22
15-20	—	—	—	—	1	9	5	3	—	18
21-25	—	—	—	—	—	1	3	1	—	5
25-30	—	—	—	—	—	6	5	3	1	15
31-35	—	—	—	—	—	—	—	2	—	2
35-40	—	—	—	—	—	—	—	—	—	—
40-45	—	—	—	—	—	—	1	1	—	2
45-50	—	—	—	—	—	—	—	—	1	1
Total	—	—	—	—	22	28	20	10	2	82

(i) Average score scored in Interview = 17.01
(ii) S.D. = 9.61
(iii) Average of Total N.S.T.S. score = 135.85
(iv) S.D. = 21.29

$r = 0.69$

The value of r is significant at 1% Level

THE DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED BY THE EXAMINEES IN PROJECT REPORT AND THEIR N.S.T.S. TOTAL EXAMINATION 1967.

N.S.T.S. Total/ Marks scored in Project Report	0-20	20-40	40-60	60-80	80-100	100-120	120-140	140-160	160-180	180-200	Total
0-2	—	7	10	3	1	—	—	—	—	—	21
3-4	1	12	6	5	1	—	—	—	—	—	25
5-6	—	9	21	13	5	2	—	—	1	—	51
7-8	—	15	19	11	7	2	1	2	1	—	58
9-10	1	16	21	22	12	2	6	2	2	—	87
11-12	—	13	17	13	13	7	4	6	—	—	70
13-14	—	4	9	12	13	4	7	3	1	—	53
15-16	—	2	1	7	13	4	2	4	3		36
17-18	—	—	—	2	7	1	3	1	1	-	17
19-20	—	—	1	1	2	1	3	1	1		10
21-22	—	—	—	—	1	—	2	1	1	1	6
Total	2	75	108	89	75	23	30	20	11	1	434

(i) Average score scored in Project Report = 10.04 (ii) S.D. = 4.43

(iii) Average of Total N.S.T.S. score = 74.05 (iv) S.D. = 36.87

$r = 0.49$

The value of r is significant at 1% level.

Table 10

THE DEGREE OF ASSOCIATION BETWEEN THE MARKS SCORED BY THE EXAMINEES IN PROJECT REPORT AND IN INTERVIEW OF THE N.S.T.S. EXAMINATION 1957.

Marks scored in Interview/Marks scored in Project Report	0-5	5-10	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50	Total
5-6	1	—	1	—	1	—	—	—	—	—	3
7-8	—	1	2	2	—	—	1	—	—	—	6
9-10	1	1	3	5	—	—	—	—	1	—	11
11-12	—	5	3	4	3	—	—	—	—	—	16
13-14	2	3	3	—	2	5	—	—	—	—	15
15-16	—	3	1	3	5	—	1	—	—	—	13
17-18	2	2	1	2	—	—	—	—	1	—	8
19-20	1	—	3	—	—	2	—	—	—	—	6
21-22	—	—	1	1	—	2	—	—	—	1	5
Total	7	16	18	17	11	9	2	—	2	1	83

(i) Average score scored in Project Report = 13.47 (ii) S.D. = 4.10

(iii) —do— in Interview = 16.79 (iv) S.D. = 9.83

r = 0.15

The value of r is not significant at 5% Level

(B) STATEWISE FREQUENCY DISTRIBUTION OF MARKS SCORED BY THE CANDIDATES IN PROJECT REPORT IN N.S.T.S. EXAMINATION YEAR 1967.

Scored Marks	A P.	Bihar	Assam	Delhi	Gujarat	Haryana	J & K	Kerala	M. S.	M P.	Madras	Mysore	Orissa	Pb.	Raj.	U.P.	U.T.	W. B.
0-5	30	65	10	22	14	30	8	22	21	97	140	80	20	18	52	25	17	68
6-10	124	85	29	70	32	31	17	167	128	257	234	154	26	36	69	90	33	195
11-15	69	20	26	103	23	34	1	165	132	82	166	146	16	33	29	125	19	155
16-20	9	4	1	69	2	25	1	24	111	17	38	51	2	4	8	16	7	84
21-25	—	1	—	4	1	6	—	2	20	—	—	3	—	1	2	2	—	9
Total	232	175	66	268	72	126	27	380	412	453	578	434	64	92	160	258	76	511
X Mean	9.3	7.0	9.4	12.3	9.2	10.9	7.1	10.6	12.8	8.3	8.9	10.1	8.0	9.5	10.0	10.7	9.1	10.8
S. D.	3.60	3.85	3 65	4.70	4.10	5.90	3.35	3.60	4.90	3.70	4.35	4.70	4.15	4.30	4.45	3.90	4.45	4.85

Note : In state of Delhi & U.P. a systematic sample of interval 3 is adopted.

APPENDIX XVII

(A) STATEWISE FREQUENCY DISTRIBUTION OF MARKS SCORED BY THE CANDIDATES IN ESSAY PAPER IN N.S.T.S. EXAMINATION YEAR 1967.

Scored Marks	A. P.	Bihar	Assam	Delhi	Guj.	Haryana	J & K	Kerala	M.S.	M.P.	Mad.	Mys.	Orissa	Pb.	Raj	U.P.	U.T.	W B.
0-5	49	20	3	21	16	4	1	7	33	75	12	43	3	9	44	34	3	12
6-10	36	13	4	22	13	5	2	12	40	38	30	65	5	2	26	37	6	28
11-15	39	15	8	31	10	11	10	73	42	85	66	71	7	5	18	22	8	41
16-20	44	36	10	41	13	36	4	74	76	224	162	88	7	26	30	54	13	113
21-25	53	33	9	77	5	38	8	66	116	79	178	116	25	28	51	76	27	124
26-30	39	56	26	66	6	39	3	72	89	28	135	85	21	32	40	53	16	137
31-35	11	24	14	24	6	12	1	51	25	12	24	8	1	9	18	23	3	50
36-40	1	7	4	5	5	—	—	29	10	4	8	2	—	—	2	4	3	7
41-45	—	1	—	1	1	—	—	1	2	—	1	1	—	—	1	2	1	1
46-50	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	272	205	80	288	76	145	29	385	433	545	616	479	69	111	230	305	80	513
X Mean	16.35	21.63	23 6	22.7	16.8	22.1	18.0	22.75	20.28	16.2	21.2	17.5	21.1	21.45	18.0	19.3	21.5	22.3
(S.D.)	9.25	9.5	9.0	7.9	11.90	6.80	7.0	8.6	8.7	7.5	6.75	8.20	7.20	8.0	5.1	9.3	8.10	7.46

Note :—In States of Delhi & U.P. a systematic sample of Interval 3 is adopted.

(B) STATEWISE FREQUENCY DISTRIBUTION OF MARKS SCORED BY THE CANDIDATES IN PROJECT REPORT IN N.S.T.S. EXAMINATION YEAR 1967.

Scored Marks	A P.	Bihar	Assam	Delhi	Gujarat	Haryana	J & K	Kerala	M. S	M P.	Madras	Mysore	Orissa	Pb.	Raj.	U.P.	U.T.	W. B.
0-5	30	65	10	22	14	30	8	22	21	97	140	80	20	18	52	25	17	68
6-10	124	85	29	70	32	31	17	167	128	257	234	154	26	36	69	90	33	195
11-15	69	20	26	103	23	34	1	165	137	82	166	146	16	33	29	125	19	155
16-20	9	4	1	69	2	25	1	24	111	17	38	51	2	4	8	16	7	84
21-25	—	1	—	4	1	6	—	2	20	—	—	3	—	1	2	2	—	9
Total	232	175	66	268	72	126	27	380	412	453	578	434	64	92	160	258	76	511
X Mean	9.3	7.0	9.4	12.3	9.2	10.9	7.1	10.6	12.8	8.3	8.9	10.1	8.0	9.5	10.0	10.7	9.1	10.8
S. D.	3.60	3.85	3 65	4.70	4.10	5.90	3.35	3.60	4.90	3.70	4.35	4.70	4.15	4.30	4.45	3.90	4.45	4.85

Note : In state of Delhi & U.P. a systematic sample of interval 3 is adopted.

APPENDIX XVIII

STATEWISE FREQUENCY DISTRIBUTION OF THE MARKS SCORED BY THE CANDIDATES IN SCIENCE APTITUDE TEST OF THE N.S.T.S. EXAMINATION MARCH 1964.

Scored Marks	Assam	A.P.	Bihar	Delhi	Guj.	H.P.	[illegible]	M.S.	M.P.	Mad.	Mys.	Orissa	Goa.	Pond.	Pb	Raj.	Tri-Pura	U.P	W.B
0-9	13	88	51	3	35	3	—	49	278	—	11	7	--	—	35	55	3	740	46
10-19	14	132	56	6	31	5	—	63	216	11	33	19	-	—	64	61	5	684	108
20-29	15	112	43	32	30	10	—	66	136	29	54	22	—	13	137	80	6	466	118
30-39	19	54	30	60	17	8	—	48	86	41	34	21	—	15	113	54	2	252	80
40-49	9	39	19	64	9	3	2	41	48	36	32	7	1	14	113	25	—	122	56
50-59	8	11	10	60	4	1	7	21	32	26	30	9	—	9	55	6	1	64	32
60-69	4	6	7	34	2	1	3	12	11	21	15	4	1	4	39	2	2	33	20
70-79	3	3	4	38	1	—	1	10	11	10	8	3	—	3	10	3	—	18	23
80-89	3	—	2	34	—	—	—	4	4	7	3	1	—	—	6	3	—	8	11
90-99	1	2	—	20	2	—	—	7	3	2	7	1	1	1	3	—	—	9	6
100-109	—	—	—	10	—	—	—	3	1	1	—	—	—	—	4	—	—	1	31
110-119	—	—	—	4	—	—	—	1	—	1	—	—	—	—	—	—	—	1	1
120-129	—	—	—	2	—	—	—	1	—	—	—	—	—	—	—	—	—	--	1
130-139	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
Total	89	447	222	366	131	35	13	326	846	186	224	94	3	59	579	309	19	2398	500
Mean ($\bar{x}$)	34.3	22.5	24.5	56.2	22.5	26.2	56.8	32.1	20.5	45.9	38 1	32.3		42.9	36.0	23.6	25.6	19.8	32.6
S.D.	21.9	15.2	18.0	23.5	17.4	13.6	8.0	23 2	17.4	20.5	21.0	19.1		15.5	18.6	15.3	17.7	16.2	21.5
V%	63.7	67.4	73.6	41.8	76.0	52.0		72.2	84.8	44.5	55.1	59.2		31.5	51.5	64.7	69.2	81.7	66.0
Rank of (v)	8	11	13	2	14	5		12	16	3	6	7		1	4	9	12	15	10

STATEWISE FREQUENCY DISTRIBUTION OF THE MARKS SCORED BY THE CANDIDATES IN SCIENCE APTITUDE TEST OF THE N.S.T.S EXAMINATION YEAR 1965

Scored Marks	Assam	A.P.	Bihar	Delhi	Guj.	Goa	H.P.	Imphal	J. & K.	Kerala	M.S.	M.P.	Mad.	Mys.	Orissa	Pond.	Pb.	Raj.	Tri-pura	U.P.	W.B.
0–9	2	112	32	24	15	—	—	1	3	10	—	319	52	6	1	2	64	90	4	638	86
10–19	7	142	44	36	31	—	6	3	6	21	14	233	77	17	2	8	88	98	8	509	69
20–29	10	130	37	46	25	—	4	—	4	11	25	143	93	33	8	14	107	60	6	273	62
30-39	10	80	23	87	10	1	3	5	3	7	29	103	160	40	9	4	85	32	5	117	42
40-49	6	37	17	100	4	1	—	—	1	7	45	109	65	30	6	13	61	15	1	60	30
50-59	3	25	9	100	2	1	—	5	—	2	48	35	38	31	5	11	26	7	2	31	41
60-69	4	6	9	60	5	1	—	—	—	1	24	19	18	9	4	7	11	7	—	16	16
70-79	—	6	3	53	1	1	—	—	—	1	12	11	12	8	2	—	7	4	1	15	22
80-89	—	3	2	35	1	—	—	—	1	1	14	1	5	5	1	—	2	—	1	6	10
90-99	—	—	2	29	—	—	—	—	—	—	12	—	1	2	—	—	1	—	—	3	10
100-109	—	2	1	12	—	—	—	—	—	—	9	1	—	2	—	—	—	—	—	3	5
110-119	—	—	1	—	—	—	—	—	—	—	5	—	—	—	—	—	—	—	—	1	1
120-129	—	—	—	2	—	1	—	—	—	—	1	—	—	1	—	—	—	—	—	—	—
Total	42	543	180	586	94	6	13	14	17	61	238	975	461	184	38	59	452	313	28	1670	394
(Mean)	33.1	23.6	26.0	50.9	23.9	64.6	22.2	35.3	20.4	24.7	50.9	21.5	31.7	41.4	41.5	37.7	28.2	19.8	27.5	17.1	33.1
S.D.	16.1	16.7	17.0	24.1	17.1			17.3	12.0	17.7	23.2	17 5	17.7	20.9	17.	18.00	17.1	15.0	20.0	15.3	26.3
V%	48.7	70.9	65.5	47.3	71.7				58.8	71.6	45.5	81.2	55.6	50.3	42.6	48.0	60.5	76.0	72.7	89.4	79.5
Rank of (V)	5	11	10	3	13				8	12	2	17	7	6	1	4	9	15	14	18	16

STATEWISE FREQUENCY DISTRIBUTION OF THE MARKS SCORED BY THE CANDIDATES IN SCIENCE APTITUDE TEST OF THE N.S.T.S. EXAMINATION YEAR 1966

Scored Marks	Assam	A.P.	Bihar	Delhi	Guj.	J K.	Kerala	M.S.	M P.	Madras	Mysore	Orissa	Punjab	Raj.	U.P.	U.T.	W. B.
0-9	16	39	14	2	19	3	3	68	246	22	2	2	11	60	288	4	3
10-19	6	52	19	20	14	1	7	65	190	46	13	2	29	66	240	3	18
20-29	13	49	30	41	3	3	12	51	100	53	18	5	53	38	126	6	36
30-39	2	27	16	61	4	4	27	29	48	54	17	3	40	14	78	13	44
40-49	7	16	12	115	4	—	29	26	26	34	17	2	41	10	36	5	36
50-59	4	10	1	85	4	—	20	21	11	19	9	4	28	1	23	1	31
60-69	3	8	1	92	5	—	22	18	7	9	7	2	8	2	14	5	22
70-79	—	—	2	73	1	—	11	6	6	2	8	4	5	4	14	3	27
80-89	—	2	—	48	—	—	8	6	3	4	5	1	1	—	6	—	15
90-99	—	—	1	25	1	—	—	4	1	—	2	1	—	1	2	—	7
100-109	—	—	—	2	—	—	1	—	—	—	2	—	—	—	1	—	—
TotalNo.of candidates	51	203	103	564	55	11	140	294	638	243	100	23	216	196	828	40	239
Mean ($\bar{x}$)	24.5	24.5	28.2	55.2	24.5	21.8	48.2	28.3	17.2	31.3	43.4	41.5	34.5	18.2	18.5	37.0	47.4
S.D.	18.2	16.4	17.2	19.8	22.2	11.9	19.5	22.3	15.1	17.1	23.2	17.3	16.3	14.5	17.3	18.5	21.6
% age of Co-efficient of Variation (v)	74.1	67.1	60.9	35.9	90.5	54.4	40.3	78.7	87.8	54.8	53.4	41.7	47.1	80.0	93.5	50.0	45.5
Rank of (v)	12	11	10	1	16	8	2	13	15	9	7	3	5	14	17	6	4

STATEWISE FREQUENCY DISTRIBUTION OF MARKS SCORED BY THE CANDIDATES IN SCIENCE APTITUDE TEST ON N.S.T.S. EXAMINATION YEAR 1967

Scored Marks	A. P.	Assam	Bihar	Delhi	Gujarat	Haryana	J & K	Kerala	M. S.	M. P.	Mad.	Mys.	Orissa	Pb.	Raj.	U. P.	U. T.	W. B.
0-9	29	9	22	—	13	—	3	—	43	160	31	11	1	5	46	78	3	19
10-19	50	5	47	5	16	10	13	4	50	170	54	33	5	17	73	76	7	44
20-29	55	9	35	22	17	29	2	20	58	107	131	61	8	24	56	66	11	56
30-39	53	19	32	31	8	23	6	47	51	50	134	81	13	14	27	42	20	66
40-49	40	16	22	51	4	28	4	75	73	32	105	96	16	21	16	19	14	52
50-59	22	15	18	37	5	22	—	73	54	17	69	82	9	17	11	14	5	59
60-69	11	5	9	39	7	17	—	72	51	12	53	57	7	7	7	11	10	60
70-79	12	3	7	49	5	8	—	44	28	6	18	38	8	6	4	4	10	73
80-89	7	1	5	26	1	4	—	27	23	7	17	15	3	3	1	5	1	37
90-99	5	—	8	16	3	4	—	10	4	2	8	6	—	1	1	1	—	28
100-109	1	—	2	11	—	1	—	4	5	1	2	1	—	—	—	1	—	18
110-119	—	—	1	2	—	—	—	—	—	—	—	1	—	—	—	—	—	4
Total	285	82	208	289	79	146	28	376	440	564	622	482	70	115	242	317	81	516
X Mean	34.4	38.4	33.2	59.5	33.3	45.3	22.8	55.9	44.3	21.3	39.2	45.9	46.1	38.7	24.1	24.5	42.6	53.0
S. D.	21.7	18.8	24.8	22.4	25.0	20.0	12.8	18.0	24.1	18.1	19.9	19.9	19.3	20.3	17.5	19.5	20.0	26.9

Note :—In States of Delhi & U.P. a systematic sample of interval 3 is adopted.

STATEWISE FREQUENCY DISTRIBUTION OF THE MARKS SCORED BY THE CANDIDATES IN SCIENCE APTITUDE TEST OF THE N.S.T.S. EXAMINATION YEAR 1966

Scored Marks	Assam	A.P.	Bihar	Delhi	Guj.	J K.	Kerala	M.S.	M.P.	Madras	Mysore	Orissa	Punjab	Raj.	U.P.	U.T.	W. B.
0-9	16	39	14	2	19	3	3	68	246	22	2	2	11	60	288	4	3
10-19	6	52	19	20	14	1	7	65	190	46	13	2	29	66	240	3	18
20-29	13	49	30	41	3	3	12	51	100	53	18	5	53	38	126	6	36
30-39	2	27	16	61	4	4	27	29	48	54	17	3	40	14	78	13	44
40-49	7	16	12	115	4	—	29	26	26	34	17	2	41	10	36	5	36
50-59	4	10	1	85	4	—	20	21	11	19	9	4	28	1	23	1	31
60-69	3	8	1	92	5	—	22	18	7	9	7	2	8	2	14	5	22
70-79	—	—	2	73	1	—	11	6	6	2	8	4	5	4	14	3	27
80-89	—	2	—	48	—	—	8	6	3	4	5	1	1	—	6	—	15
90-99	—	—	1	25	1	—	—	4	1	—	2	1	—	1	2	—	7
100-109	—	—	—	2	—	—	1	—	—	—	2	—	—	—	1	—	—
Total No. of candidates	51	203	103	564	55	11	140	294	638	243	100	23	216	196	828	40	239
Mean ($\bar{x}$)	24.5	24.5	28.2	55.2	24.5	21.8	48.2	28.3	17.2	31.3	43.4	41.5	34.5	18.2	18.5	37.0	47.4
S.D.	18.2	16.4	17.2	19.8	22.2	11.9	19.5	22.3	15.1	17.1	23.2	17.3	16.3	14.5	17.3	18.5	21.6
% age of Co-efficient of Variation (v)	74.1	67.1	60.9	35.9	90.5	54.4	40.3	78.7	87.8	54.8	53.4	41.7	47.1	80.0	93.5	50.0	45.5
Rank of (v)	12	11	10	1	16	8	2	13	15	9	7	3	5	14	17	6	4

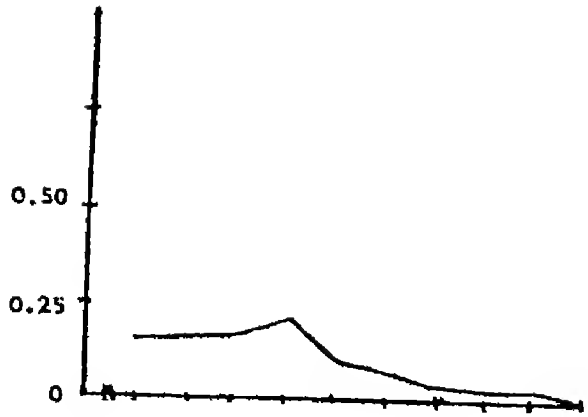
STATEWISE FREQUENCY DISTRIBUTION OF MARKS SCORED BY THE CANDIDATES IN SCIENCE APTITUDE TEST ON N.S.T.S. EXAMINATION YEAR 1967

Scored Marks	A. P.	Assam	Bihar	Delhi	Gujarat	Haryana	J & K	Kerala	M. S.	M. P.	Mad.	Mys.	Orissa	Pb.	Raj.	U. P.	U. T.	W. B.
0–9	29	9	22	—	13	—	3	—	43	160	31	11	1	5	46	78	3	19
10–19	50	5	47	5	16	10	13	4	50	170	54	33	5	17	73	76	7	44
20–29	55	9	35	22	17	29	2	20	58	107	131	61	8	24	56	66	11	56
30–39	53	19	32	31	8	23	6	47	51	50	134	81	13	14	27	42	20	66
40–49	40	16	22	51	4	28	4	75	73	32	105	96	16	21	16	19	14	52
50–59	22	15	18	37	5	22	—	73	54	17	69	82	9	17	11	14	5	59
60–69	11	5	9	39	7	17	—	72	51	12	53	57	7	7	7	11	10	60
70–79	12	3	7	49	5	8	—	44	28	6	18	38	8	6	4	4	10	73
80–89	7	1	5	26	1	4	—	27	23	7	17	15	3	3	1	5	1	37
90–99	5	—	8	16	3	4	—	10	4	2	8	6	—	1	1	1	—	28
100–109	1	—	2	11	—	1	—	4	5	1	2	1	—	—	—	1	—	18
110–119	—	—	1	2	—	—	—	—	—	—	—	1	—	—	—	—	—	4
Total	285	82	208	289	79	146	28	376	440	564	622	482	70	115	242	317	81	516
X Mean	34.4	38.4	33.2	59.5	33.3	45.3	22.8	55.9	44.3	21.3	39.2	45.9	46.1	38.7	24.1	24.5	42.6	53.0
S. D.	21.7	18.8	24.8	22.4	25.0	20.0	12.8	18.0	24.1	18.1	19.9	19.9	19.3	20.3	17.5	19.5	20.0	26.9

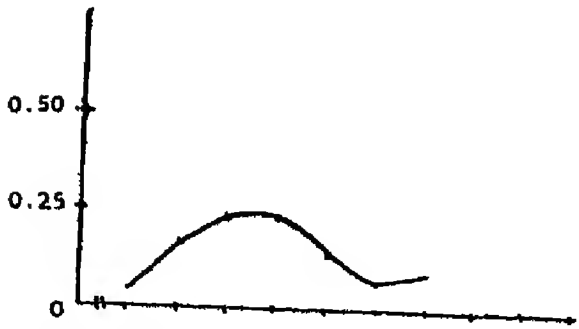
Note :—In States of Delhi & U.P. a systematic sample of interval 3 is adopted.

ASSAM

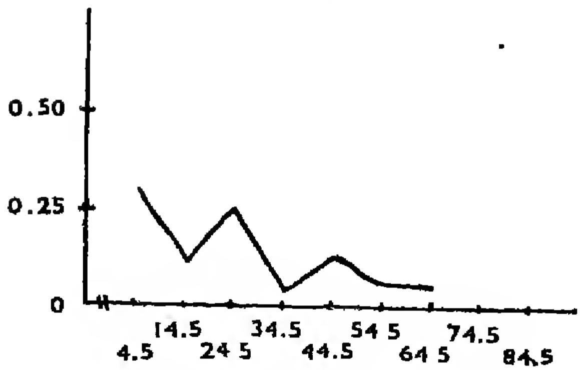
YEAR 1964



YEAR 1965

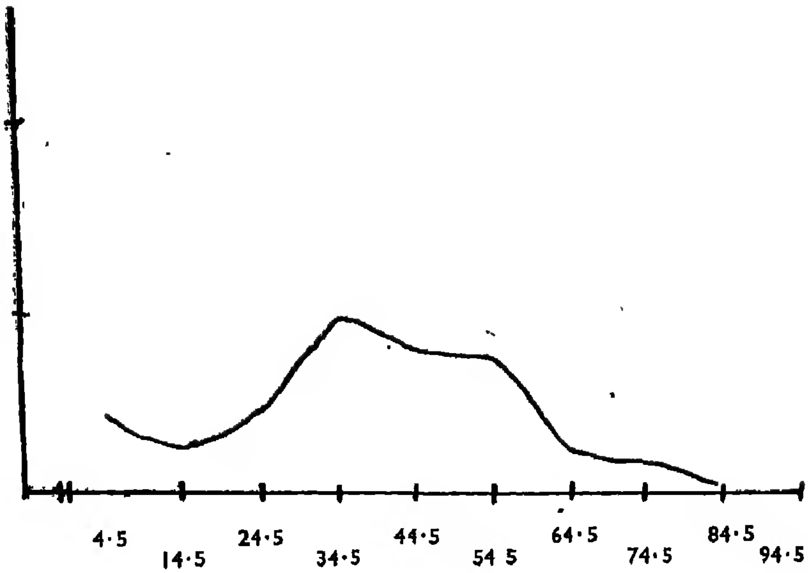


YEAR 1966



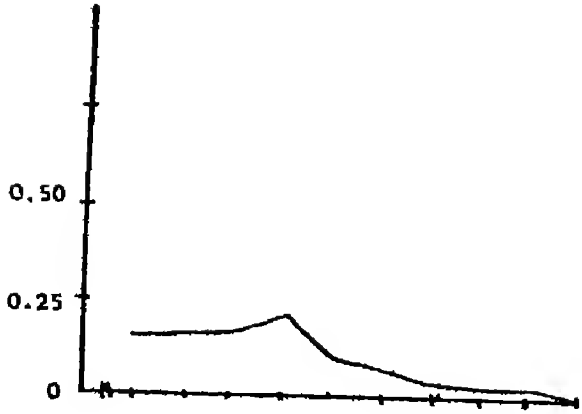
ASSAM

YEAR 1967

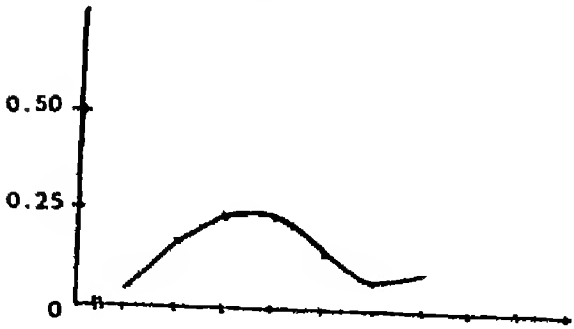


ASSAM

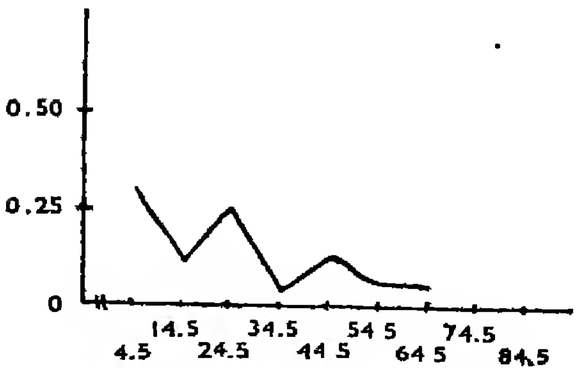
YEAR 1964



YEAR 1965

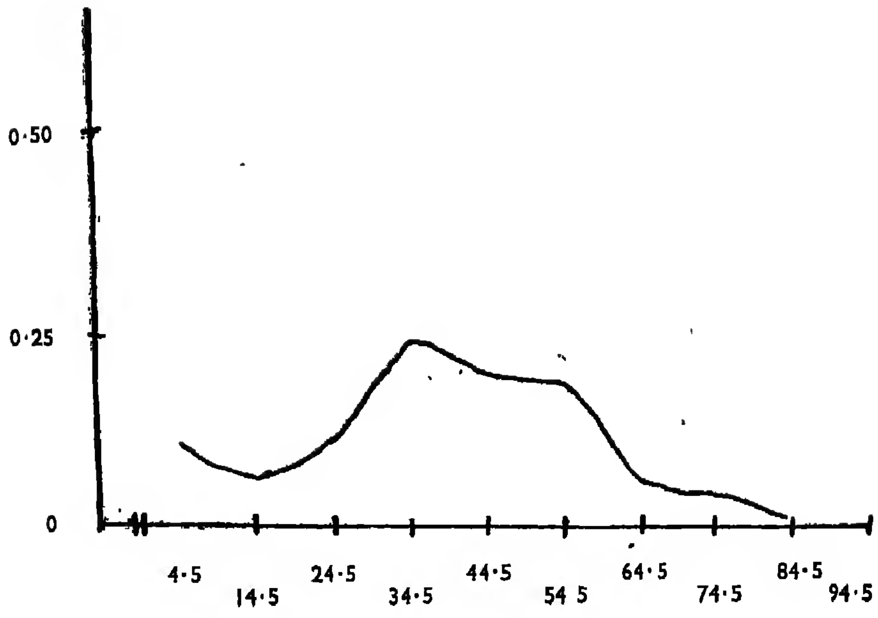


YEAR 1966



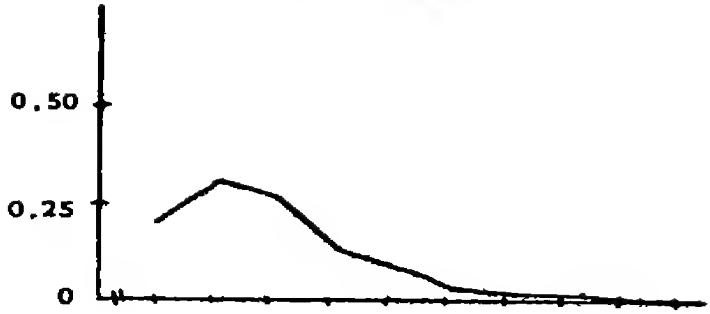
ASSAM

YEAR 1967

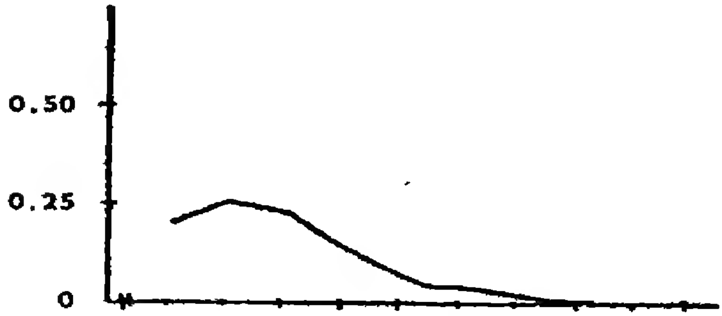


A. P.

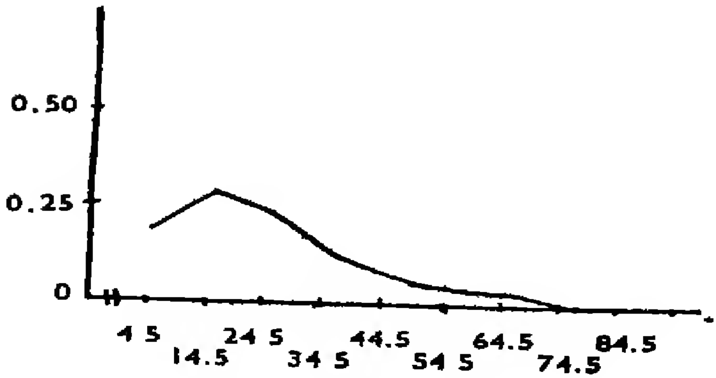
YEAR 1964



YEAR 1965

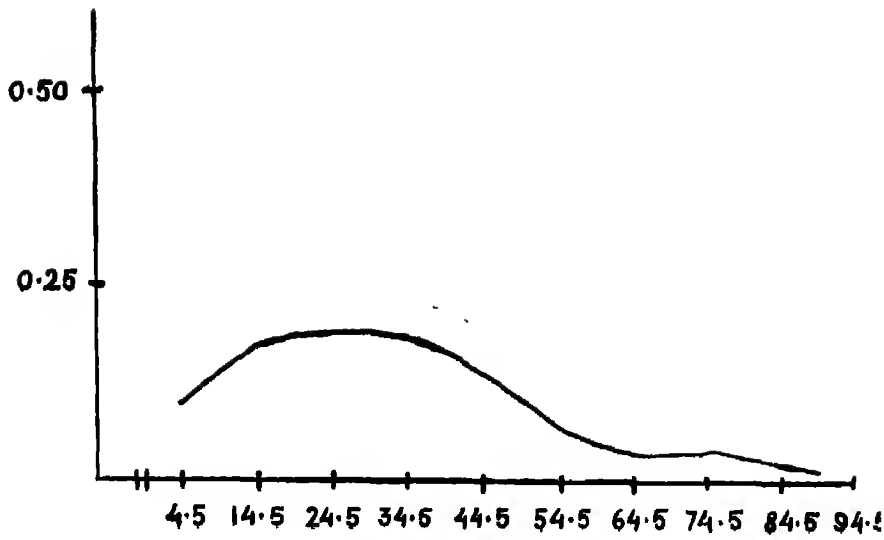


YEAR 1966



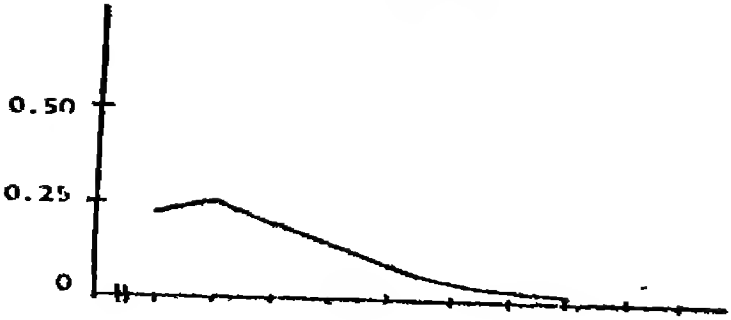
A. P.

YEAR 1967



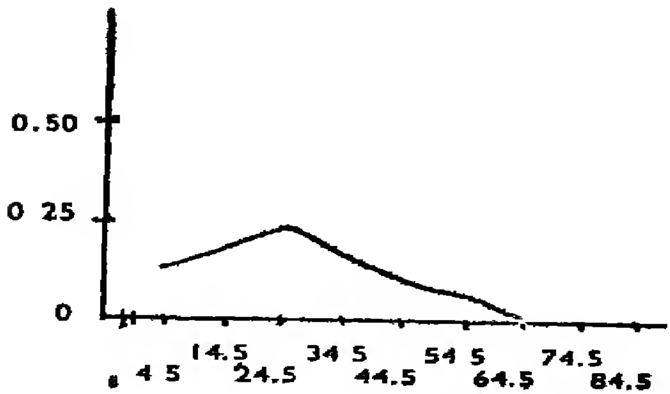
BIHAR

YEAR 1964



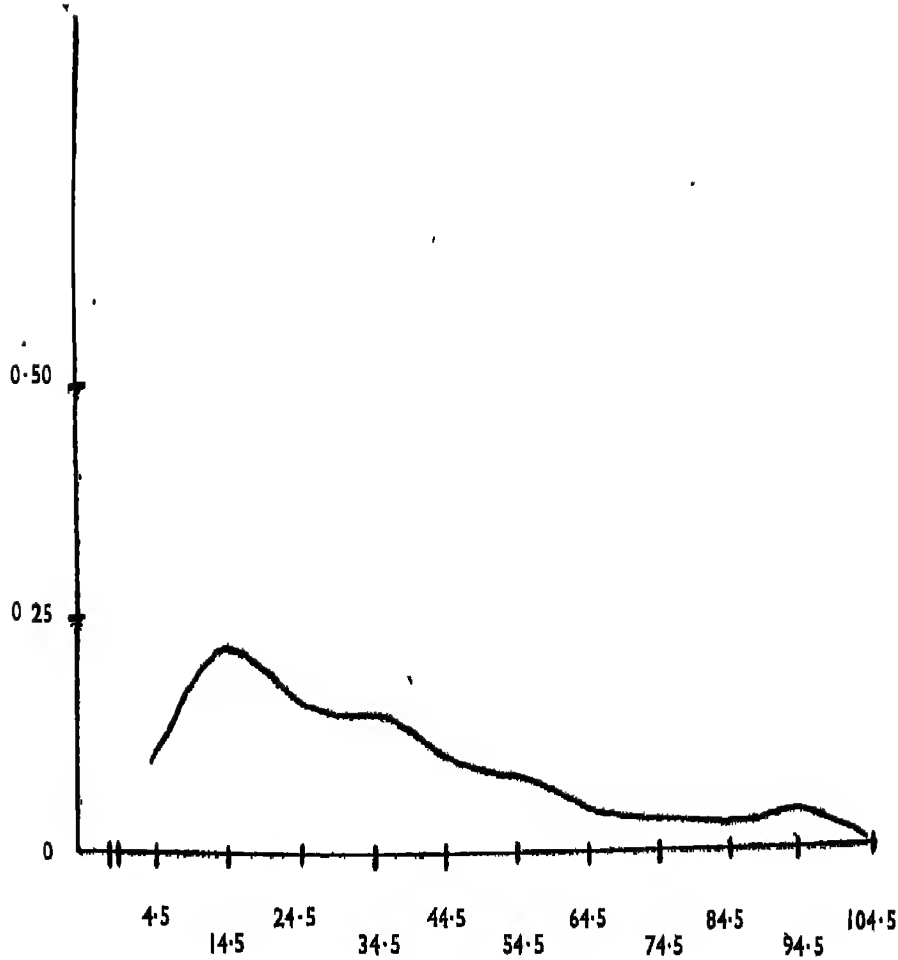
YEAR 1965

YEAR 1966



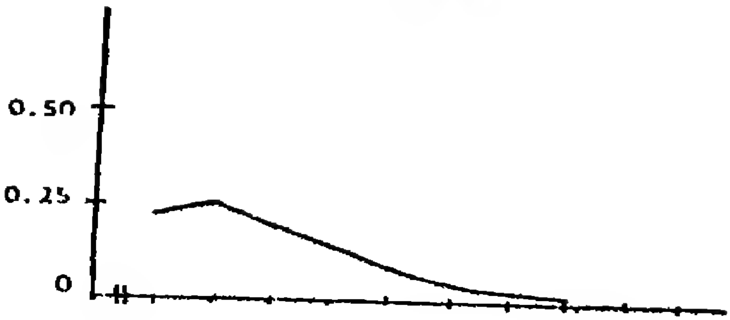
BIHAR

YEAR 1967

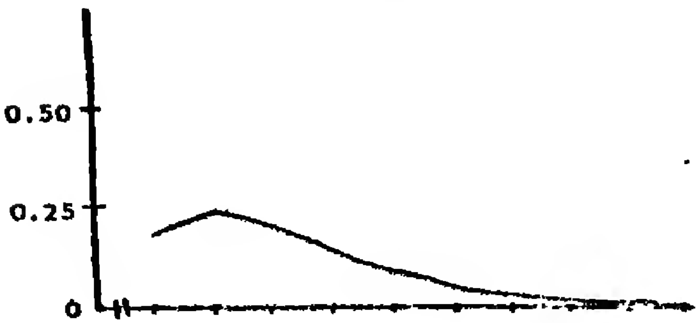


BIHAR

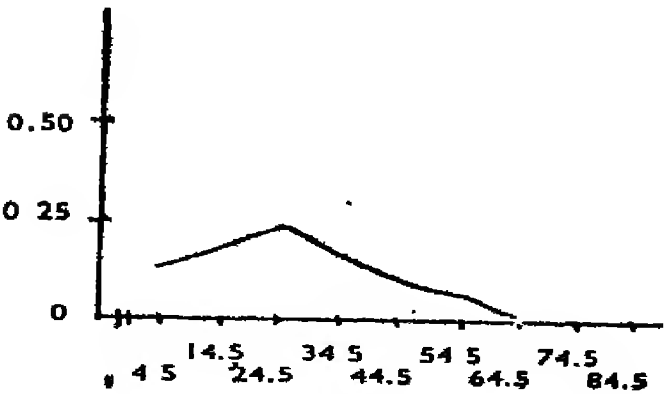
YEAR 1964



YEAR 1965



YEAR 1966



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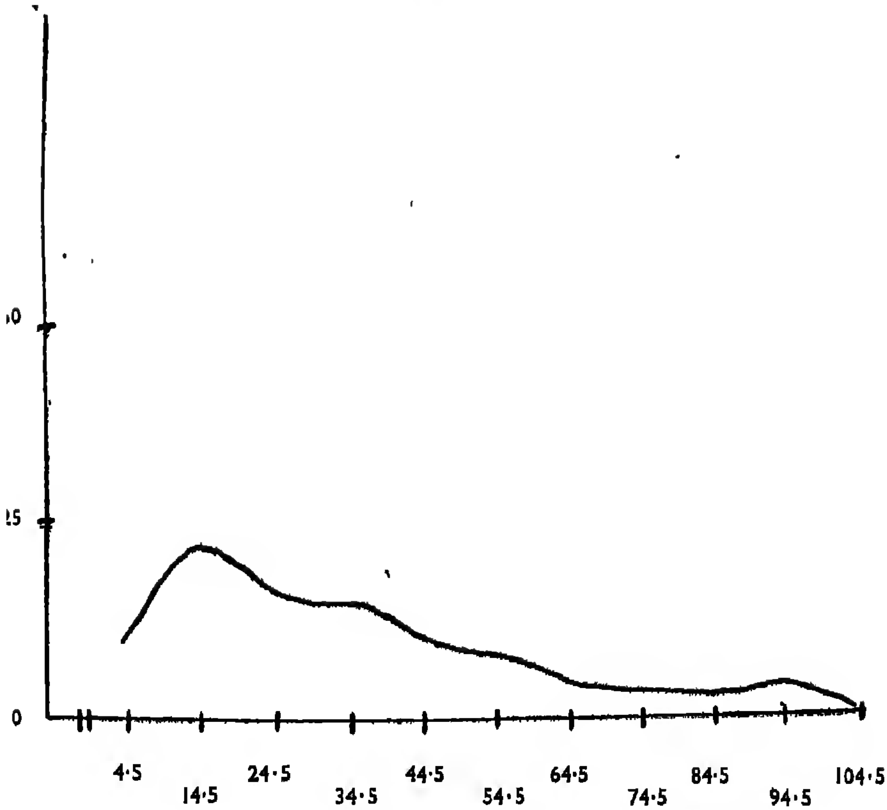

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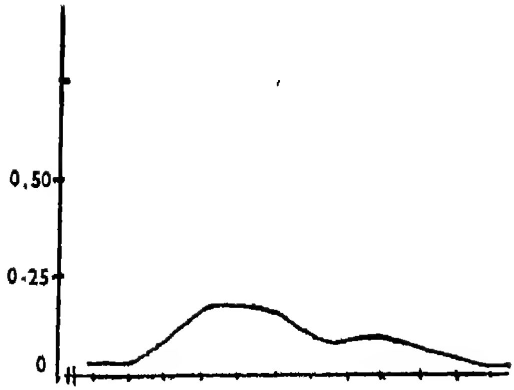

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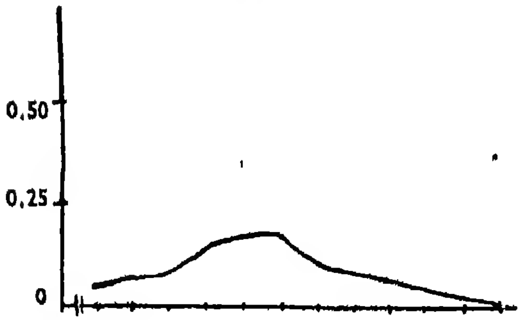

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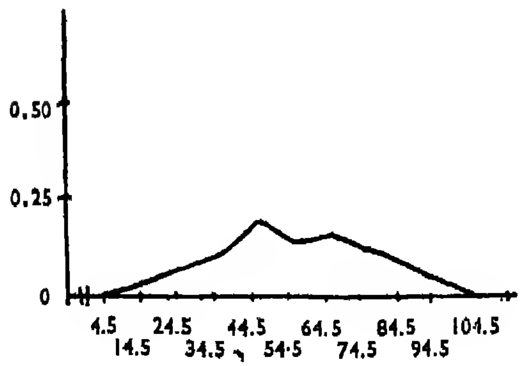

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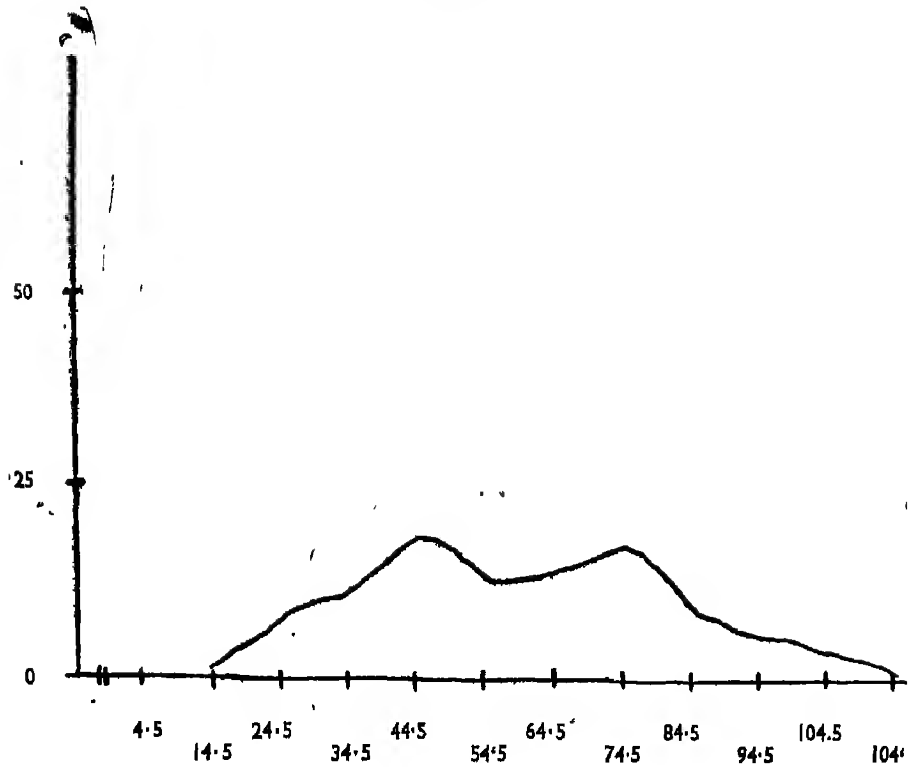

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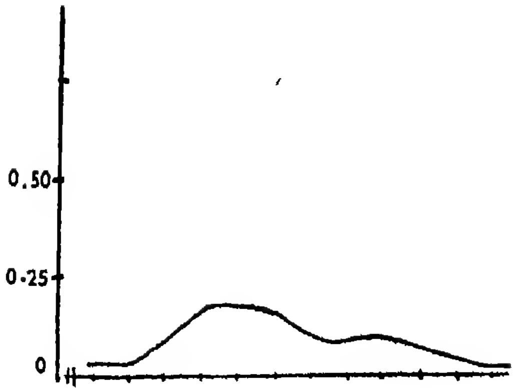
YEAR 1964



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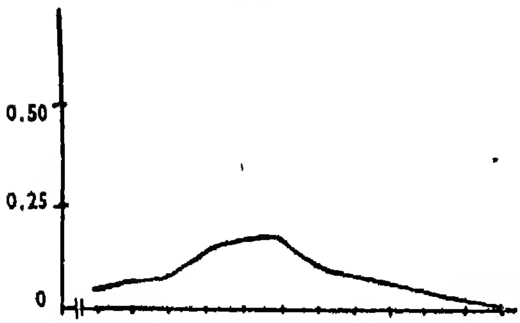

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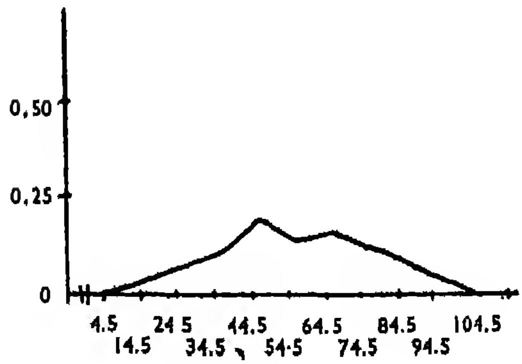

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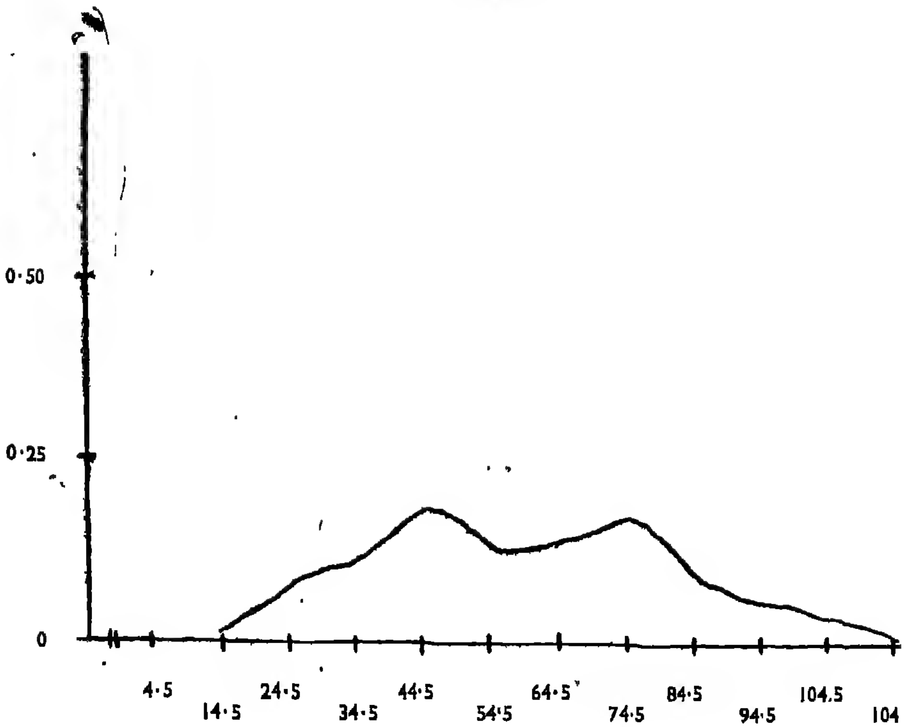

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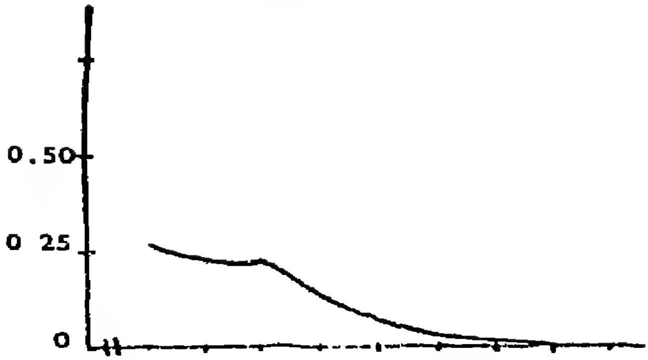
YEAR 1964



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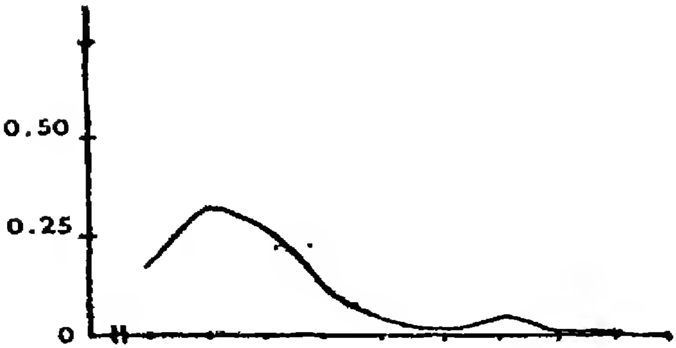

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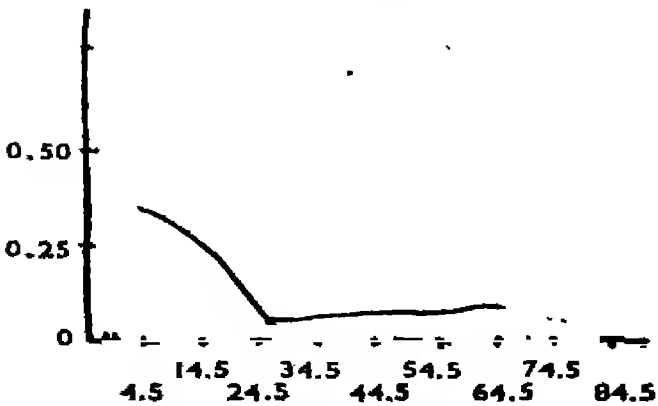

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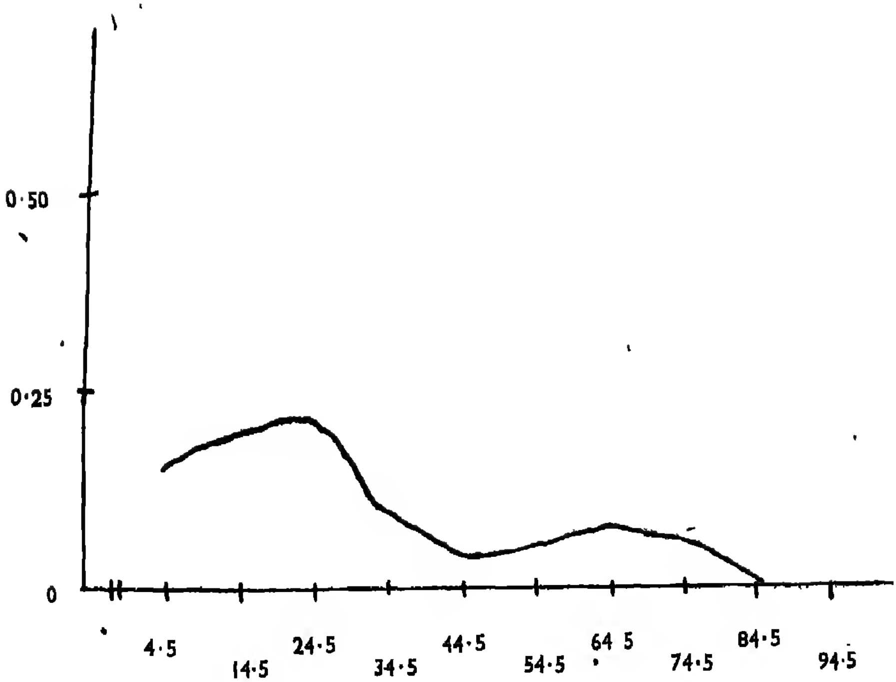
YEAR 1967



KERALA

YEAR 1964
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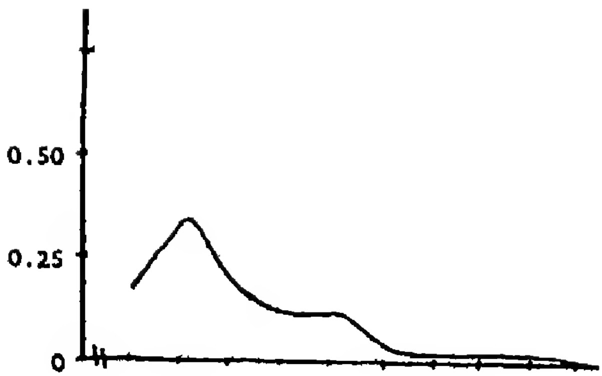
YEAR 1965



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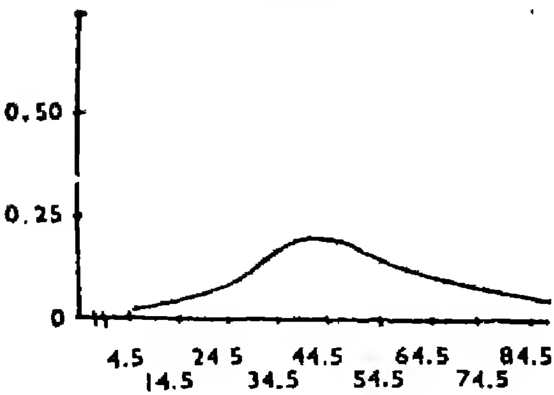

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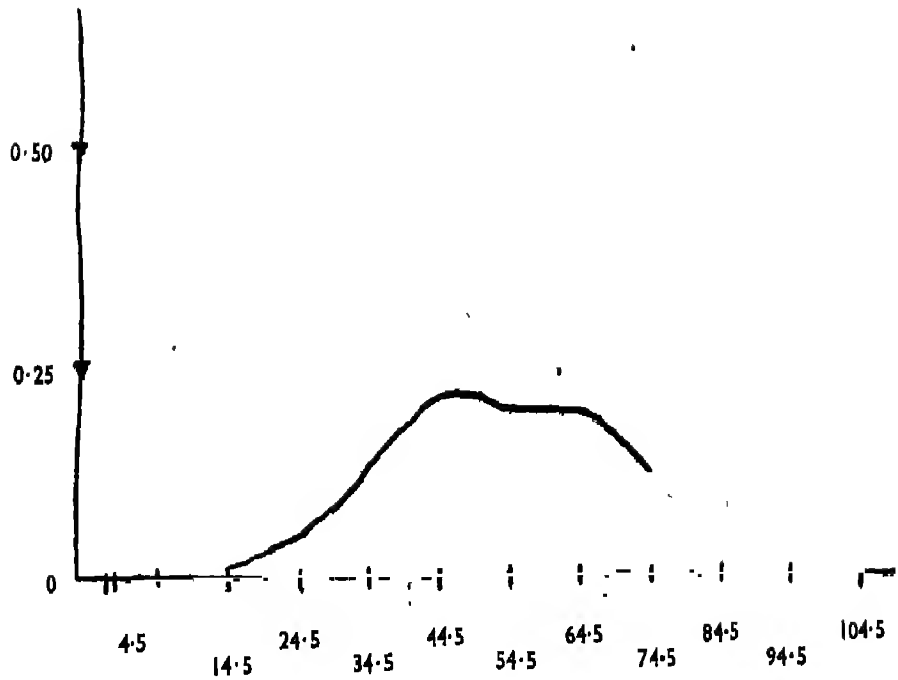

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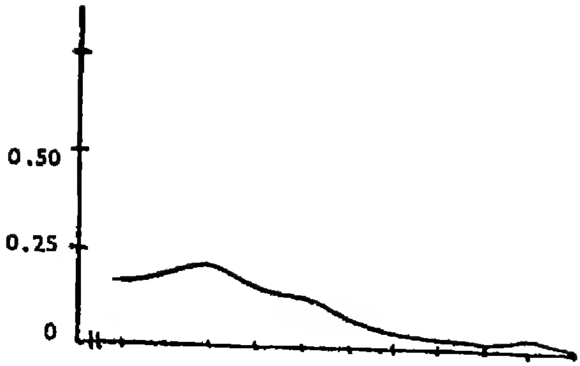
YEAR 1964



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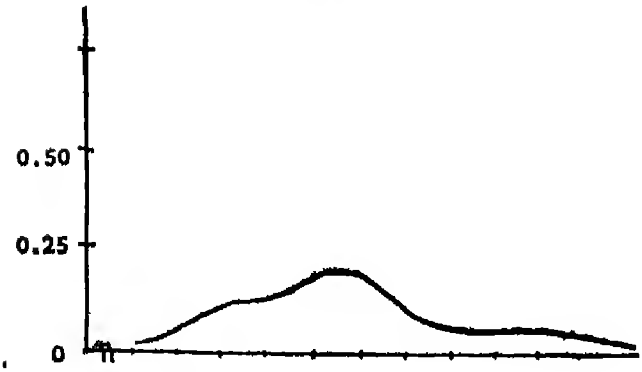

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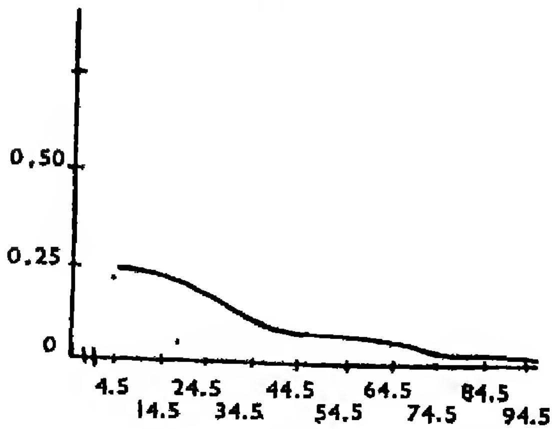

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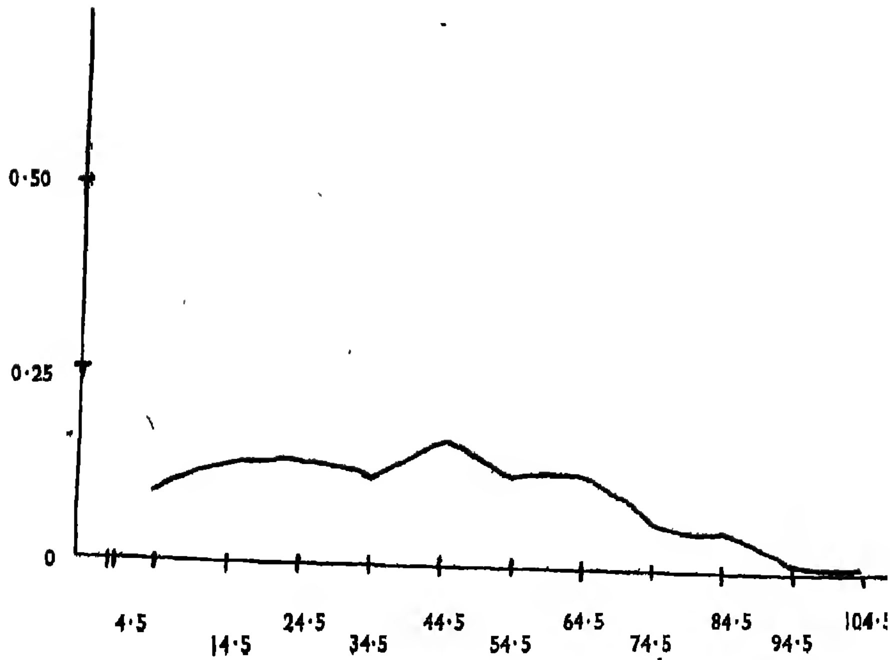

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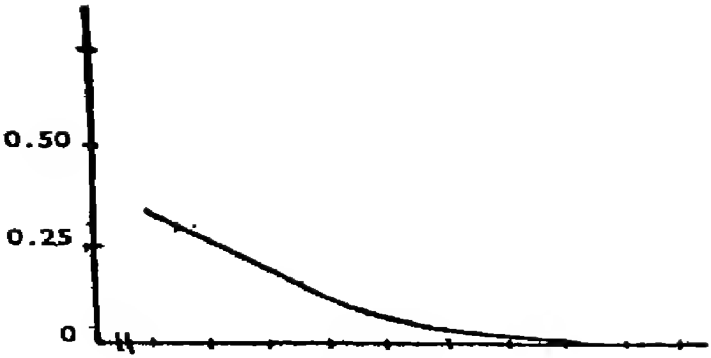

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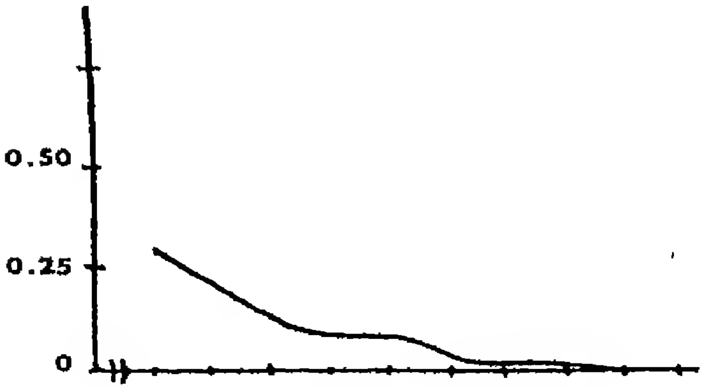

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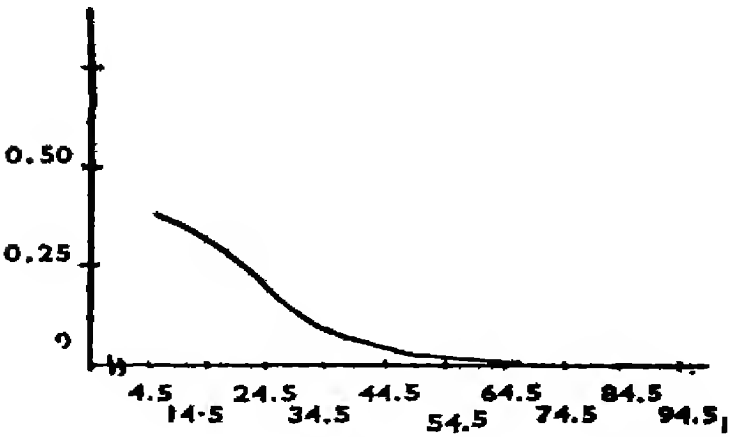

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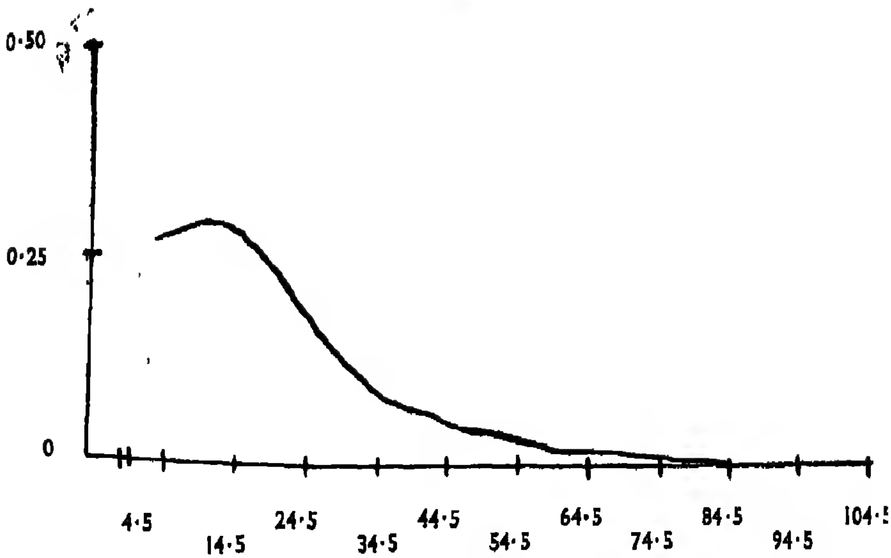
YEAR 1967



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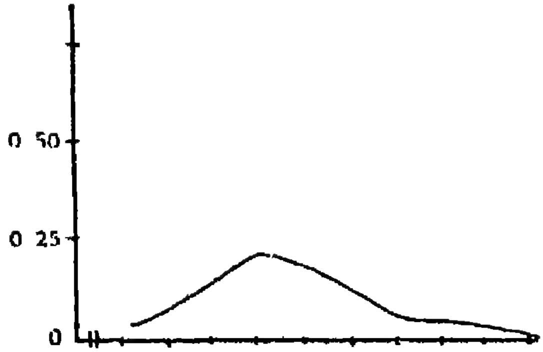

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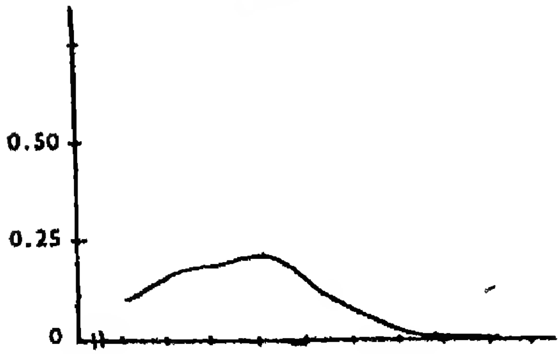

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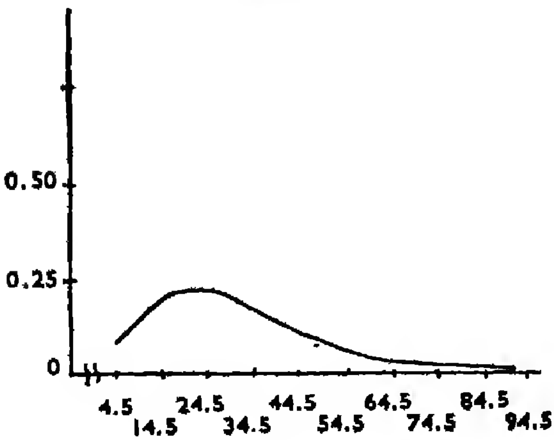

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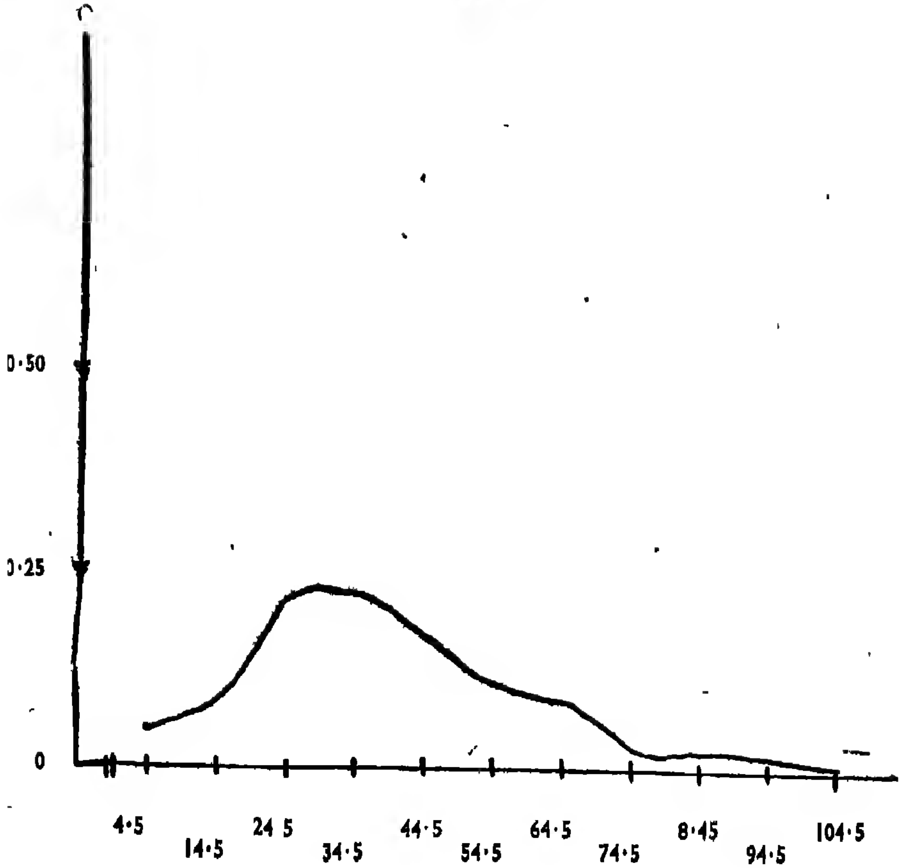

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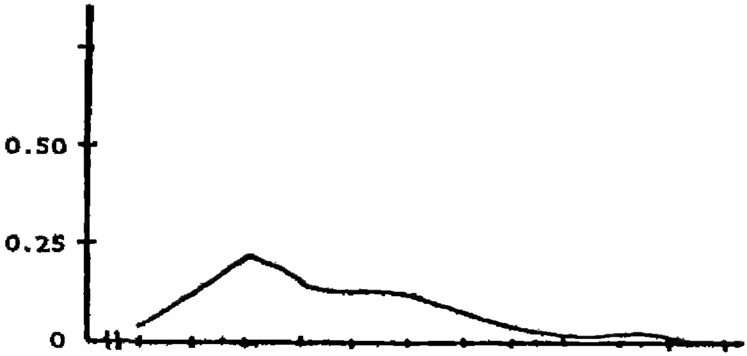
YEAR 1964



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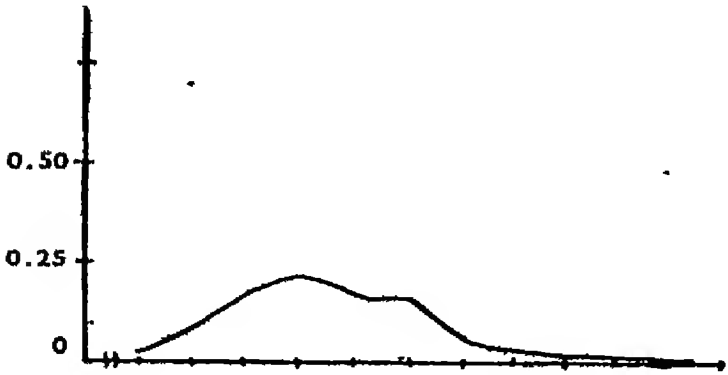

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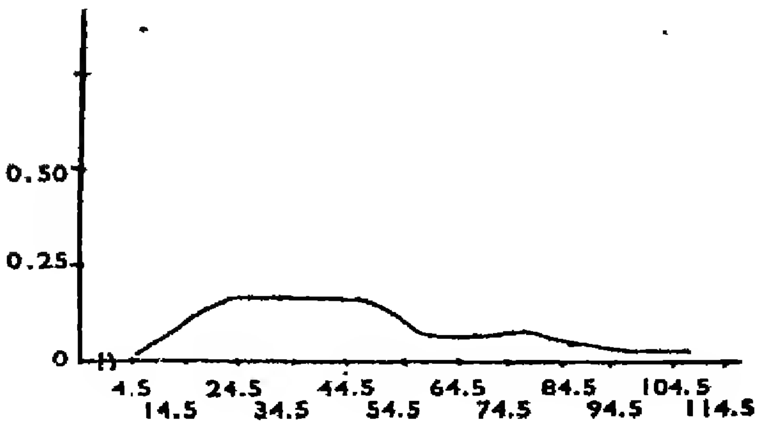

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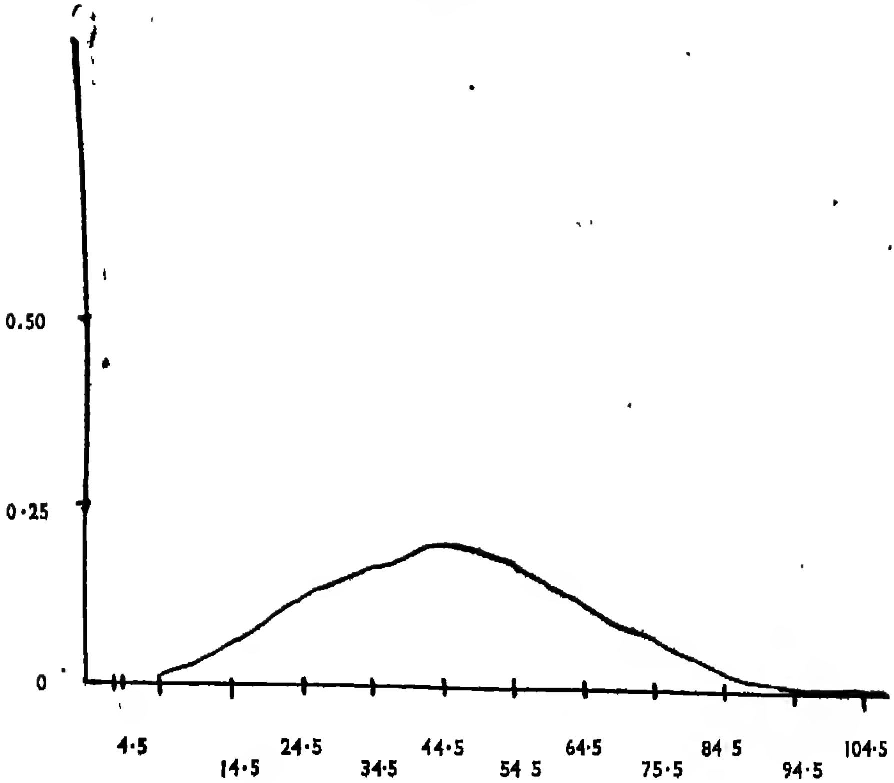
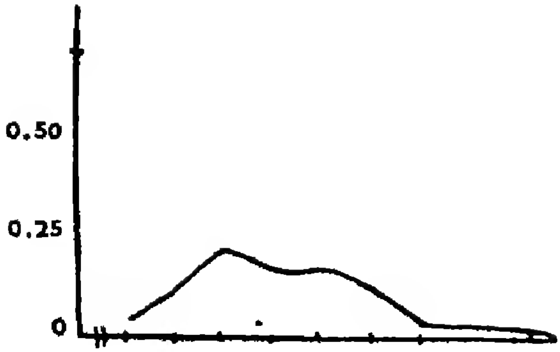
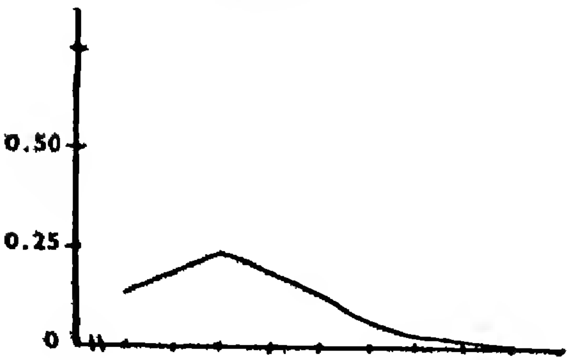


PUNJAB

YEAR 1964



YEAR 1965



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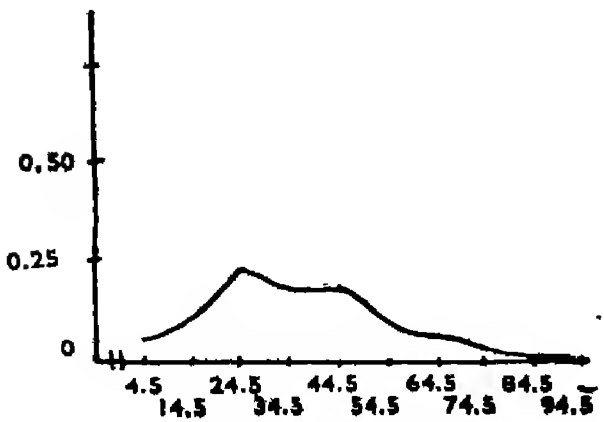

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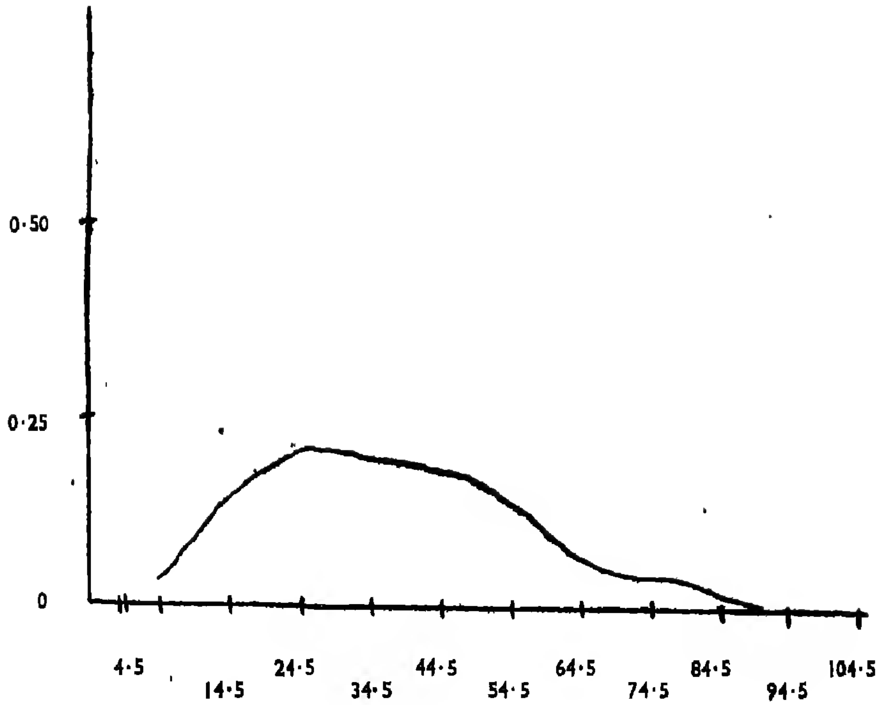

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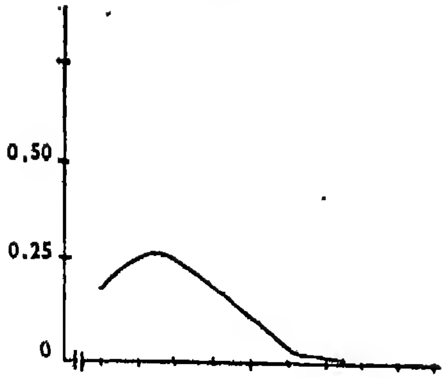
YEAR 1964



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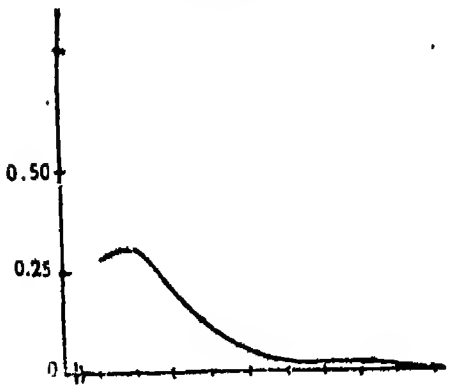

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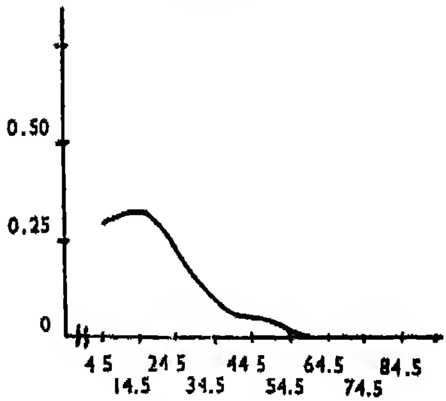

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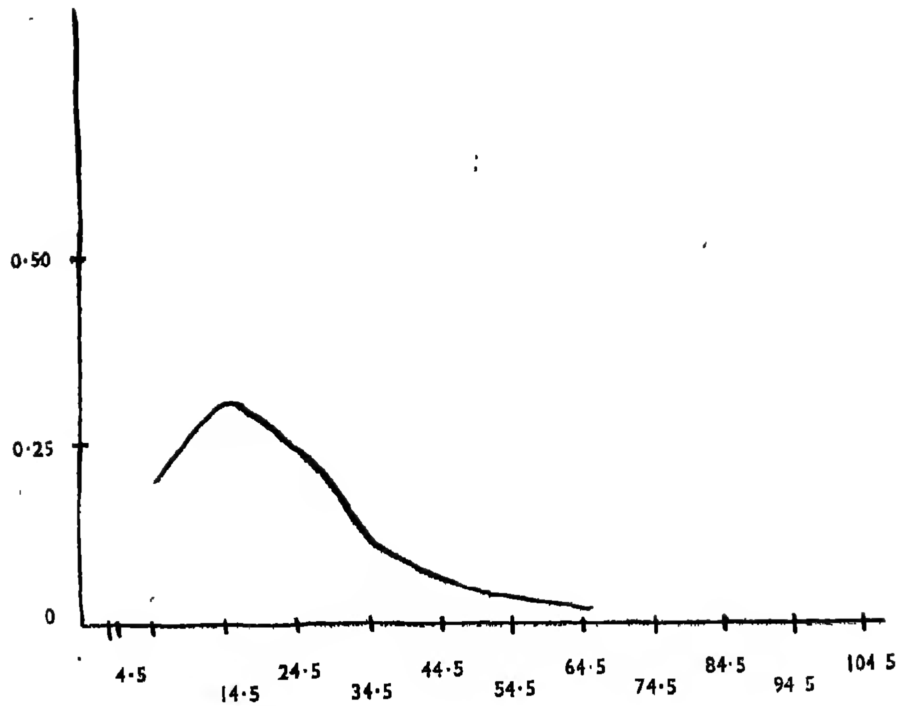
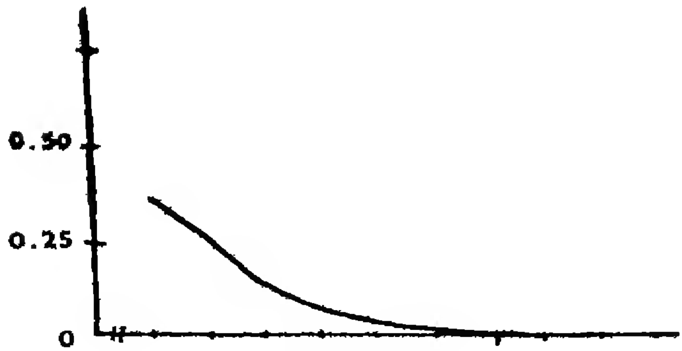


U. P.

YEAR 1964

YEAR 1965



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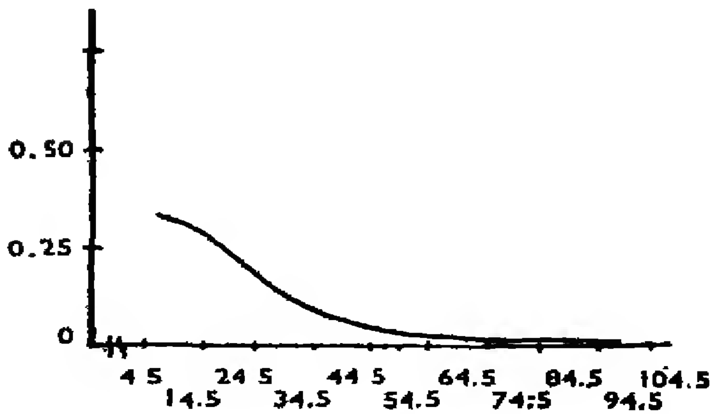

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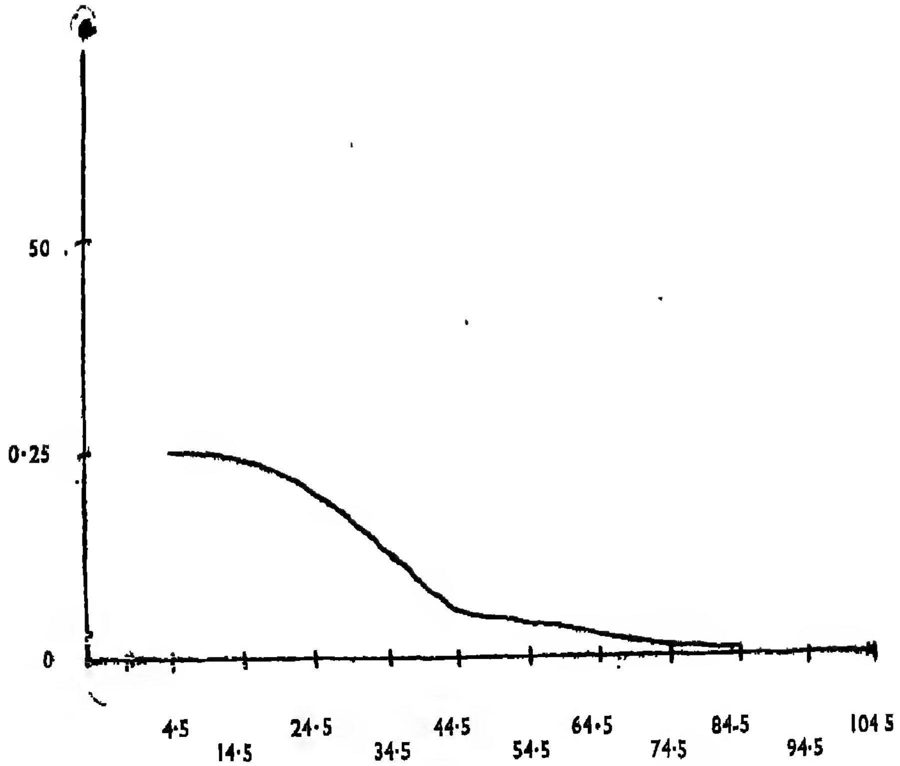
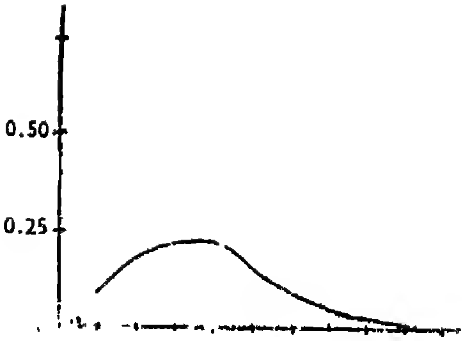
YEAR 1967



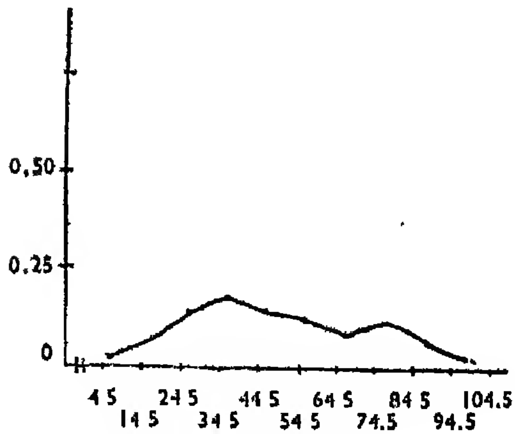
W. BENGAL

YEAR 1964



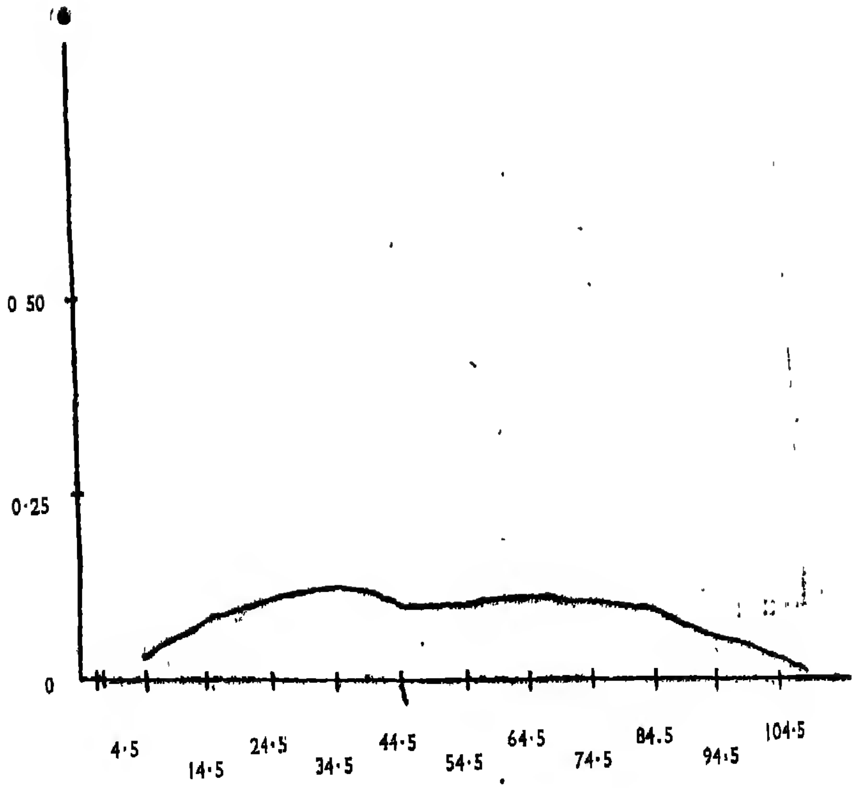
YEAR 1965

YEAR 1966



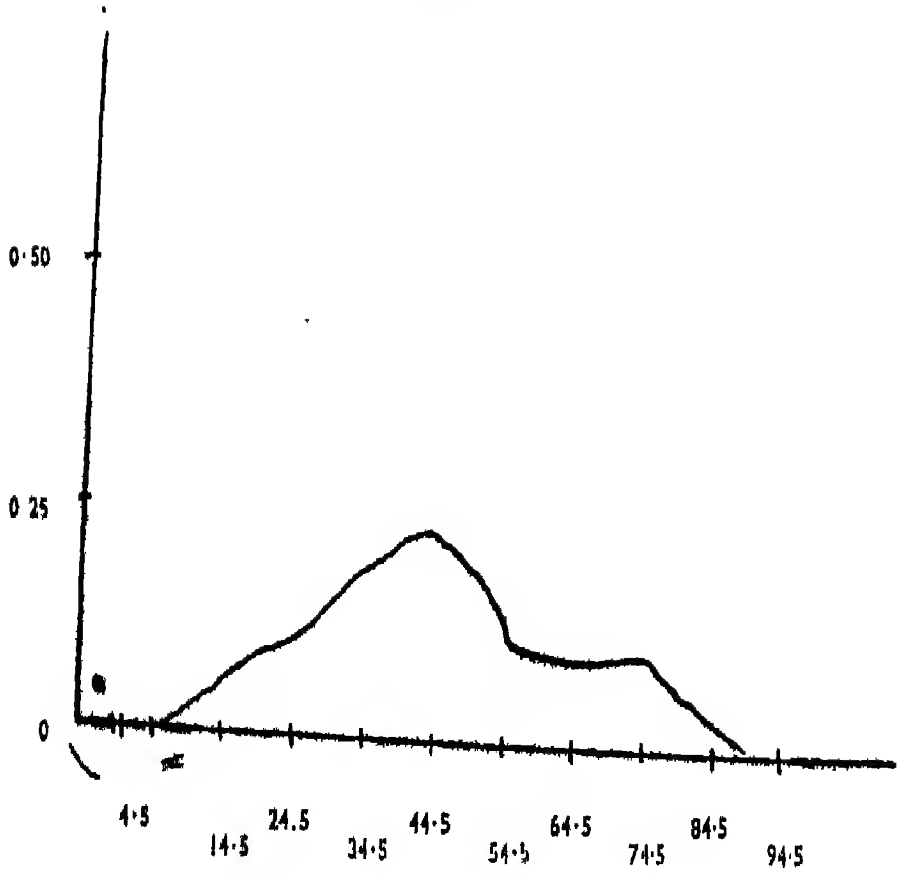
W. BENGAL

YEAR 1967



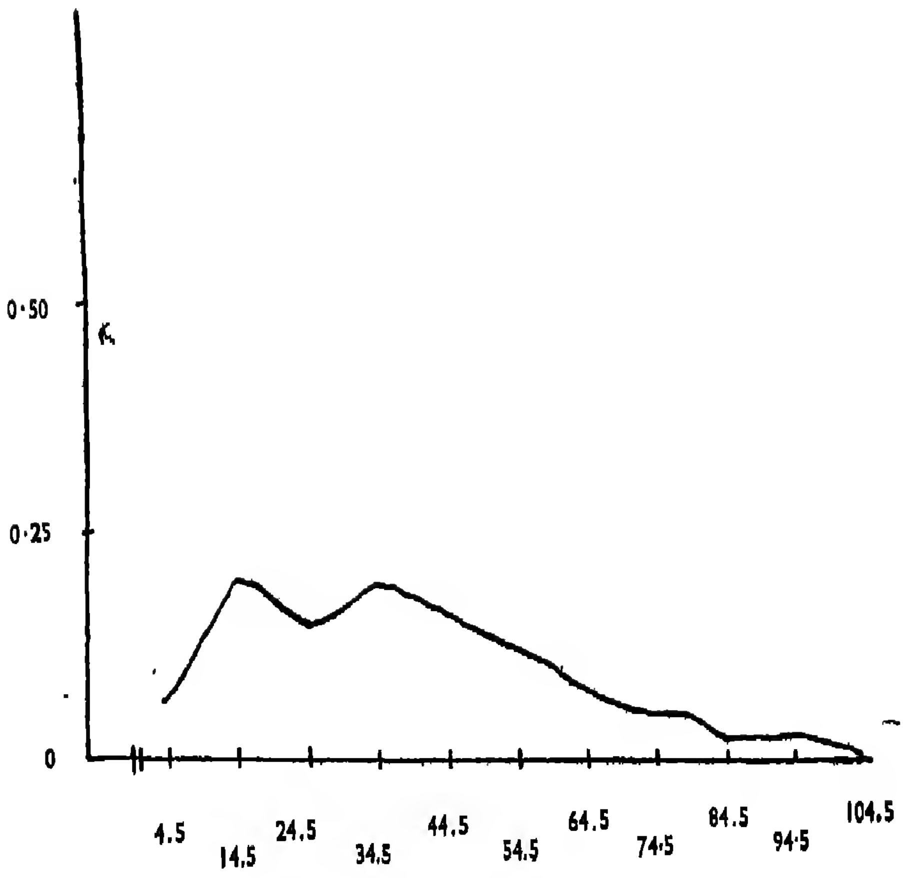
ORISSA

YEAR 1967



HARYANA

YEAR 1967



APPENDIX XIX

TABLE A

PREDICTIVE AND FOLLOW-UP (COMPARATIVE) DATA OF A RANDOM SAMPLE OF STUDENTS WHO SECURED FIRST CLASS AT THE HIGHER SECONDARY EXAMINATION 1967 AND WHO SECURED A PLACE IN THE MERIT LIST OF THE SCIENCE TALENT SEARCH EXAMINATION AS AGAINST THOSE WHO COULD NOT SECURE A POSITION

		Unselected Group			Selected Group				
1	2	3 (Sample size)	4 (Mean)	5 (S.D.)	6 (Sample size)	7 (Mean)	8 (S.D.)	9 (C.R.) Value	Significance Level
1.	Science Aptitude Test Score	60	73.153	9 153	50	88.10	12.319	7.216	1%
2.	Essay Score	60	25.583	4.831	50	28.50	7.316	2.525	1%
3.	Project Score	60	11.516	4 653	50	15.06	3.941	4.212	1%
4.	Interview Score	58	13.706	5.869	50	25.54	6.670	9 694	1%
5.	Total N.S.T.S. Score	58	121.120	9.645	50	157.46	13.373	15.390	1%
6.	Mathematics score in %age (Hr. Secondary)	54	78.84	11.183	49	82.247	13.259	1.587	Not Significant
7.	Physics score in %age (Hr. Secondary)	60	70.856	9.674	50	74.208	9.643	1.792	5%
8.	Chemistry score in %age (Hr. Secondary)	60	69.670	9.231	50	73.658	8.611	2.299	5%
9.	Biology score in %age (Hr. Secondary)	36	63.334	7.623	23	65.265	7.090	0.927	Not Significant
10.	Total Score in %age (Hr. Secondary)	60	71.498	8.020	50	75.536	7.123	2.735	1%

TABLE B

PREDICTIVE AND FOLLOW-UP (COMPARATIVE) DATA OF A RANDOM SAMPLE OF STUDENTS WITH REGARD TO THEIR POSITION IN Ist YEAR OF THE B.Sc. (PASS/HONS) COURSES AND WHO SECURED FIRST CLASS AT THE HIGHER SECONDARY EXAMINATION 1966 AND WHO SECURED A PLACE IN THE MERIT LIST OF THE SCIENCE TALENT SEARCH EXAMINATION YEAR 1966 AS AGAINST THOSE WHO COULD NOT SECURE A POSITION.

	Unselected Group			Selected Group			Significance Level (C.R)
	N	Mean	S.D.	N	Mean	S.D.	
1. Science Aptitude Test Score	58	52.758	10.624	55	74.436	14.225	highly significant
2. Essay Paper Score	58	23.741	7.359	55	27.381	6.924	5%
3. Project Report Score	57	10.157	4.258	55	13.054	3.782	5%
4. Interview Score	51	11.588	8.059	55	20.318	7.525	1%
5. Total N.S.T.S.	51	98.00	9.752	55	134.890	15.462	highly significant
6. Mathematics Score in %age (B.Sc. Ist year Pass/Hons)	46	69.493	18.632	27	72.077	17.168	5%
7. Chemistry Score in %age (B.Sc. Ist year Pass/Hons)	58	67.106	14.265	34	64.206	14.069	not significant
8. Biology Score in %age (B.Sc. Ist yeas Pass/Hons)	11	60.872	10.794	12	65.825	5.449	5%
9. Physics Score in %age (B.Sc. Ist year Pass/Hons)	57	64.970	10.00	51	65.057	10.638	not significant
10. Total score in %age (B.Sc. Ist year Pass/Hons)	60	66.418	11.138	60	65.178	10.602	not significant

TABLE C

PREDICTIVE AND FOLLOW-UP (COMPARATIVE) DATA OF STUDENTS WITH REGARD TO THEIR POSITION IN THE FINAL YEAR OF THE B.Sc. (PASS/HONS) COURSE AND WHO SECURED FIRST CLASS AT THE HIGHER SECONDARY EXAMINATION 1964 AND WHO SECURED A PLACE IN THE MERIT LIST OF THE SCIENCE TALENT SEARCH EXAMINATION YEAR 1964 AGAINST THOSE WHO COULD NOT SECURE A POSITION

	Unselected Group			Selected Group			
	N	Mean	S.D.	N	Mean	S.D.	Significance Level (C R)
1. Science Aptitude Test score	49	53.693	9.467	40	73.425	21.092	highly Significant
2. Essay paper score	49	24.785	7.45	40	30.625	6.366	5%
3. Project Report Score	41	8.439	3.012	39	10.205	3.306	not Significant
4. Interview score	38	16.052	6.801	40	39.60	11.655	highly significant
5. Total N.S.T.S. Score	36	102.750	10.995	40	157.225	24.277	-do-
6. Mathematics Score %age (B.Sc. IIIrd year Pass/Hons)	25	70.224	13.455	18	74.105	16.695	5%
7. Physics score in %age (B.Sc. IIIrd year Pass/Hons)	28	62.60	11.417	21	64.662	8.317	not significant
8. Chemistry score in %age (B.Sc. IIIrd year Pass/Hons)	36	61.44	7.954	28	63.089	10.176	-do-
9. Biology score in %age (B.Sc. IIIrd year Pass/Hons)	14	59.730	7.165	22	60.754	7.049	-do-
10. Total aggregate in %age (B.Sc. IIIrd year Pass/Hons)	49	63.342	8.685	36	67.44	10.564	5%

STUDY—1

A STUDY OF THE DIFFERENT CORRELATES CONTRIBUTING TO THE ACADEMIC SUCCESS OR FAILURE OF N.S.T.S. SCHOLARS

PART—A

Patterns of difficulties of National Science Talent Search scholars who could not continue the scholarship during their M.Sc. courses

Dr. K.N. Saxena
Sri Ved Ratna

The Problem :

For sometime, recently, the authors and their Colleagues in the Department of Science Education, N. C. E. R. T. have been worrying about the reasons why so few of the N. S. T. S. awardees in B.Sc. III Yr. have continued their scholarship for their studies in M.Sc. Out of the awardees of 1964 there were 143 in B.Sc. III Yr. (excluding those in the Honours School at Chandigarh who complete B.Sc. after drawing scholarship for 4 years and then complete M.Sc. in one year) during the session 1966-67 but only 76 (i.e. 53%) continued the scholarship during the session 1967-68. Out of the awardees of 1965 there were 151 in B. Sc. III Yr. during the session 1967-68 but during the month of Sept., 1968, only 52 have sent their claims of scholarship and certificates of regular attendence for the months of July & Aug., 1968.

There is a strict condition for the continuance of the N.S.T.S. scholarship in M. Sc., that one must obtain a first class in B. Sc. However, this condition is not a legitimate explanation for about 47% drop-outs. On one hand, money spent on these drop-outs is alarming, on the other hand such a large percentage of drop-outs, if all have failed to obtain a first class in their B. Sc., reflects on the capabilities of students selected through the N.S.T.S. examination. Because the brightest students are selected all over the country by the examination, one will naturally expect that a much higher percentage of these should obtain a first class at the university examinations, although the two examinations are of quite different nature.

An attempt has been made in the present paper to study the reasons for discontinuance of scholarships by so many students.

What is to be Investigated ?

There can be three aspects of this problem in which ivestigation may seem necessary :

(i) The efficiency of tools of selection of N.S.T.S. scholars may be doubted and it may be investigated as to how these tools Can be improved so as to select such scholars as may have greater probability of obtaining a first division in university examinations.

(ii) The N.S.T.S. scholars (and the community of brilliant students in general) may be facing certain problems in our country, to which sufficient attention has not yet been paid by educationists.

(iii) If the percentage of N.S.T.S. scholars who get first division is much more than 53%, than what is it ?

The authors feel that the first issue raised above need not really be investigated. According to the aims of the N.S.T S. scheme, the selection tools (viz., science aptitude test, etc.) select a different kind of talent than that selected by a first division in the university examination. Therefore, the efficiency of these tools should be judged against the aims of the scheme and not against the number of first division in university examinations.

However, since the existing examination in the universities of our country and the over-whelming importance attached by society to a first division at these examinations cannot be changed over-night, we can ill-afford to let N S.T S. scholars lose first division in university examinations. After their selection, these students have to be so trained that they develop their creative abilities as well as do well at the examinations. Thus the second and third issues raised above need immediate attention and have been investigated in this paper.

Manner of Investigation :

Early in July, 1968 the questionnaire at appendix (A) was sent to 67 awardees of 1964 who could not continue their scholarship in M. Sc. (Prev.) during the session 1967-68. Out of these 17 responded.

At the same time the questionnaire was sent to all the 151 awardees of 1965-batch, who were in their B. Sc. III Yr. during the session 1967-68. Replies were sent by 87 students of which 52 obtained first class and showed willingness to continue the scholarship, 10 studying at Calcutta University were waiting for their results and apparently desired to continue the scholarship and the rest 25 fell in the category of those who could not or did not propose to continue the scholarship.

Table (1) represents the patterns of replies of these 25 respondents of the 1965-batch, and also of the 17 respondents of this category of the 1964-batch.

It may appear in the first instance that since the response to the questionnaire was poor this study is completely unreliable. But there are reasons to

believe that neither could a batter response be expected (except by issuing repeated and strong reminders) nor could a better response give substantially more information than has been obtained now.

The 17 respondents of 1964-batch seem to be those acute cases who are dis-satisfied with their fortune even after they completed their B. Sc. In fact, many of the replies contain specific requests that the circumstances under which they were compelled to give up the N.S.T.S. scholarship be considered and the scholarship may be renewed. The situations with 25 respondents of 1965-batch tabulated in table (1) also seem to be similar. Perhaps those students, who having lost the N.S.T.S. scholarship either found a suitable occupation or obtained admission in a course of study in which they found satisfaction and also had enough money of their own to pursue the studies, did not respond.

Obviously this study should elicit the reactions only from such acute cases. Had an attempt been made that all students give replies, it is likely that many of them would have written imaginary reasons or difficulties which were not really their personal experience. However, the difficulties of students revealed in table (1) are probably true to some extent for the 50 students from the 1964-batch who did not respond and an approximately the some number from the 1965-batch.

Interpretation of Results.

It is not possible to draw precise results from this study due to poor response. But still an educationist, by supplemeting the tables (1) and (2) with his experience, can draw some valuable conclusions.

In table (1), ranks of the awardees in each category of reasons have been tabulated. We have pooled the corresponding frequencies for 1964 and 1965 in different bands of ranks in order to have a better sample.

The table (2) gives the distribution of students, who discoutinued the scholarship and replied to the questionnaire among various bands of ranks in the N.S.T.S. examination. It also covers those who lost first division.

This table shows that students of all ranks in the N.S.T.S. examination are almost equally likely to lose first division in the university examinations, excepting those in the top category of ranks (viz., 0-50). In the lowest category the lack of response; perhaps, may be due to their failure at the scholastic examination.

(i) First Divisioner Drop-outs :

First of all it may be observed in tabe (1) that those awadees who continued scholarship in their M. Sc. are not the only awardees who obtained first division in their B. Sc. There are 3 first-divisioners among the 17 of 1964-

batch. Extrapolating this number for 67 awardees of this batch who could not continue the scholarship in their M. Sc., it can be estimated that there must be atleast a dozen first divisioners among these. In fact the first divisioners were less likely to respond to the questionnaire than those who could not obtain a first division. Thus the number of first divisioners among 1964-awardees can be safely placed at about 100 out of a total of 143 and only one-third of them lost the first division. Those first divisioners who gave up the scholarship did so either in preference to a professional career, or due to not being able to get admission in M. Sc. in an institution recognized by the N.C.E.R.T.

(ii) Cases of Illness :

Among 37 who did not get first division, 19, i.e., about half (or extending the calculation, to all the students, about one-sixth of all the awardees studying in B. Sc. III Yr.) have lost first division due to illness, either of their own or of some one in their family. This reflects the poor state of health among bright and studious students in our country. Many of these students have subsequently joined M. Sc. courses in one of the pure sciences. Obviously these were very genuine cases for continuance of the scholarship provided they could maintain their health and consequently obtain a first division. There seems to be an urgent necessity that health services in school and colleges be strengthened and the brighter students be subjected to more detailed and more frequent examination than is done at present.

Personal Guides of the N.S.T.S. awardees should keep in close touch with their study habits. It seems desirable that if an awardee has not been able to take the whole or an substantial part of his examination due to ill-health, the N.C.E.R.T. may, after necessary scrutiny, allow him to study at his own cost in the class which he repeats, and then renew the scholarship when he goes to the next class after attaining the required standard of achievement in the examination. It also seems desirable that if an awardee has missed first division by a narrow margin on account of his illness immediately before the examination, he may be allowed to get the scholarship, provided he proves his worth otherwise. In fact, a decision in this respect has already been taken.

At this point a caution about the accuracy of the number of cases in this category must be mentioned. Among the 19 cases who have reported their illness or death of some one in their family to be the cause of losing a first division, there may be a few false statements. Thus a student, who had actually been neglecting studies, may pretend illness to be the cause of his poor performance in the examination. In fact, among these 19 cases,

the authors could identify 3 whose descriptions appeared vague. On the other hand, there where 10 cases who made clear and categorical statements which appeared to be true.

An argument can also be made that a student, who has taken only a part or the whole of the examination, cannot be considered ill or physically or mentally unfit for taking the examination. However, the authors are not inclined to accept this argument. We know from experience that it often happens with a sincere and bright student that he maintains weak health due to studying too much, or develops excessive worry by ordinary stresses and strains of life.

Thus the correct number of cases in the category under discussion should be at least ten in number, if not nineteen. These ten cases also are sufficient in number to justify the observations and suggestions made above for them.

(iii) The highly Emotional idealists :

There is a significant number of awardees (3 out of 17 respondents from 1964-batch and 3 out of 25 respondents from 1965-batch) who claim to have been a victim of the anomaly between the ideal and the practical. Whereas, on one hand we encourage students to try to understand their subject instead of cramming the information and to do some scientific activity outside the class.room beyond the curriculum; on the other hand the existing exminations give little credit for these activities. No doubt, efforts for improvment of the examination system are being made now-a-days on a National scale in our country. But neither is it possible to bring about this improvement within a day, nor can it be said that the existing system of examination has only demerits.

These students seem to be the highly emotional idealist type, who on being encouraged to do some good work can completely absorb themseleves in that work and forget the hard facts of life which vitally affect them. Thus they spend much of their time in reading deeply about a few topics which interest them and perhaps do some creative work in those topics. They very easily forget the fact that they should study for the examination too (whether it is good or bad at present) a fact which is glaringly brought to their notice everyday by the teaching of the topics of the curriculum in the class-room. Near the examination they find themselves unable to revise their course properly within the time at their disposal.

Semester system is a very significant improvement which has started finding place in our universities and which can help such students, but this too is not the complete answer to their problems. If within one semester, too, such a student will not study the entire course prescribed for this semester, he

cannot avoid the tragedy of showing a poor reverse, thoug he will have opportunities to improve his result later. If we look at the life of an adult too, we find that a sentimental and idealist behaviour to the extent of neglecting routine duties of life makes a slightly unbalanced personality.

The only possible help for such a student is a personal guide who may be in close touch with his progress. The guide can inspire him to work in the right direction according to the need of the time and to do some creative original work and to study a few topics to as much depth as his curiosity and interest demand. It may be realized that such type of students, if they have a high intelligence and are properly guided, can become good scientists.

At this point, again, a caution about the accuracy of the number of cases in this cetegory must be mentioned. There may be some false cases. A student may get a poor university result on account of his own bad habits negligence towards studies and pride over a good rank in the N.S.T.S. examination. When he shows poor result at the final examination, he tries to throw the blame on the society by posing himself as an emotional idealist as described above. However, from the circumstances in which this study has been made, the authors feel that only a small minority among the six cases reported in this category are false. It is not possible to identify the false cases precisely from the replies given. Their identification is possible only by the personal guides of the students who can be in close contact with their academic progress and leisure-time activities.

(iv) Marginal cases :

Seven students who lost first division by a narrow margin, have claimed certain university regulations and practices to be responsible for their failure. The regulations/practices referred to by these students do appear to be controvertial. But once a student knows about the requirements for a first division in his university, even if they are hard compared to a neighbouring university, he must work to fulfil those requirements. If he fails to fulfil them, he should not throw the blame on those regulations.

However, these students deserve attention just on account of their numbers among the drop-outs. They certainly evidence a frustration existing among students against certain university regulations and rigid rules of the N.C.E.R.T. to continue scholarship only if one gets a first division.

These cases seems to overlap with those placed in the category of "Emotional Idealists". In that category, there are some students who lost first division by a narrow margin and seems to be modest enough to find fault with themselves and frankly admit their failure.

In making the above observations the authors do not mean that some relaxations in the rules for continuance of N.S.T.S. scholarship after B.Sc. and

M.Sc. are necessary, But they do mean that if these students could be properly guided and made to work a little harder, there could be quite a substantial addition to the number of first divisioners among the N.S.T.S. awardees. As pointed out earlier, we can ill-afford to let N.S.T.S. scholars lose first division in university examinations. Loss of first division by a N.S.T.S. scholar will mean a much poorer future career for him in spite of about thirty thousand rupees of public funds spent on his education. However, the matter needs detailed examination.

Scope of further Investigation :

This study, having been made with only one source of information (viz. the replies of the students), is necessarily incomplete. The information obtained had to be supplemented by plausible guess to build up a coherent picture at every stage. Thus there is much scope for a deeper probe into this problem by pooling information from other sources, e.g., guides of students, their parents and the detailed record of their marks in class-tests, half-yearly examinations and annual examinations, etc.

However, this study highlights the chief reason (without assessing their relative importance) due to which the N.S.T.S. scholars do not continue the scholarship, and due to which some bright students fail to show good results at university examinations. It also raises several other issues which need investigation and are closely allied to this problem, some of which are as follows :

(i) Does a highly emotional idealist usually get proper marks in his school and university examinations ? Is so, why ? How does his performance at the N.S.T.S. examination compare with that at the university examinations ?

(ii) What are the career opportunities for a Ph. D. in pure sciences in India for pursuing a career as a research worker in his Subject ?

(iii) How do the seats available in India in Post-graduate courses, which can lead to a research career in pure sciences, compare with the number of first class science graduates aspiring for this career ?

(iv) How the opportunities for a research career in India compare with careers available to a first class science graduate abroad, and careers in other fields available in India ?

(v) How far are the students in our universities enlightened about opportunities for a research career in India and are encouraged to take up this career ?

(vi) Is the general stand of health of those students who obtain top positions in the examinations usually poorer then that of those students who obtain second division or third division ? If so,

what factors contribute to it? If the reverse is true, then what factors are responsible for it?

(vii) If someone in a family is ill, then every member of the family has naturally to give some attention to the patient in the form of calling the doctor, bringing medicine, caring about routine necessities of the patient and giving medicine at the proper time, keeping watch of the patient and encouraging, entertaining him whenever necessary, etc. If there is a student of about 19 in that family, how much and in what form has he to attend on the patient; can this attention be so much as to interfere with his studies, and does a wiser and more intelligent student usually give much attention to the patient?

The authors invite the views of the educationists on these issues.

Acknowledgment :—

The authors are extremely grateful to Dr. R.N.Rai, Department of Physics and Astro-Physics, University of Delhi for his valuable guidance in writing this paper.

TABLE : (1)

Categories of replies received as reasons of discontinuing the N.S.T.S. scholarship after B.Sc. III Yr.

	1964-Batch	1965-Batch
(a) Number of awardeess in B.S.c. III Yr.	143	151
(b) Number of awrdees who continued their scholarship in M.Sc. (Pr.) (uptill the 30th Sept.. 1968	76	52
(c) Number of awardees to whom questionnaire was sent	67 (drop-outs)	151
(d) Number of awardees who filled in the questionnaire and submitted an explanation for the non-continuance of the award.	17	25
(e) Number of awardees who replied that they propose to continue the scholarship (in response to questionnaire sent in July, 68) ...	76 (already conti-nuing)	62 ("Result awaited" are in-cluded)

S.No.	Category of response	Rank No. of awardees in the NSTS examination 1964-Batchh	1965-Batch
1.	No reasons mentioned	Nil	32
2.	**First Divisioners :**		
	(a) I am a first divisioner I applied for admission in one of the selected Universities recognized by the N.C.E.R.T. but could not get admission/got admission in a University which is too far from my parental town and being a girl student I cannot study there. I am continuing in an unapproved institution which deserves approval by N.C.E.R.T./I am compelled to drop studies this year.	56 (No, of students : 2)	277
	(b) I am a first divisioner. A career in Pure-Science puts an upper limit to my ambition as I can, at the most, become a teacher in a university. I have joined course in the B.E. (3-year) which I think is necessary in atomic research.	213 137 (No. of students : 3)	40
3.	**Cases of Illness :**		
	I was ill during/immediately before examinations. Due to illness my attempt at B. Sc. Part-I was a poor II-division and I made up a lot in the Part-II but missed I-division by a narrow margin of about 1%: There was a death in my family the night before examinations commened and I had attended to illness of the deceased for quite a long time before death. For the last	199 159 88 (III) 283 164 199 343	166 (94 D) 89 224 (III) 242 123 287

1	2	3	4
	two years my eyes were defective. I had nervous tension during the exams. Due to bad health I spoiled first few papers and then dropped/still continued for the fear of losing scholarship inspite of a desire to drop out.		277 216 140 287 (D) 89 (No. of Students : 19)
4.	**Emotional Idealists :** I am not accustomed to cramming and the examinations demand it giving no scope for originality. The courses are dry. I concentrated on the study of topics that interested me and there was lack of guidance. Studies in the college were wrongly oriented. I was interested in the study of modern books and gave non-routine answers in the exams. I was encouraged to study in an unconventional manner, I did so and I have received much applaud for my science outside the class-room. I could not properly plan the revision of the course in the limited time available for this purpose before the examinations.	132 81 (C) 82. (III) 157 199 (No. of students : 6	20
5.	**Distraction :** There is a workshop near my house, which disturbed me constantly during my study hours. I had some family-difficulties and had to study in an atmosphere where concentration was not possible.	343 (No. of students : 2)	264
6.	**Marginal Cases :** Marking in life-sciences is usually low and scholarship should be continued in M.Sc. if	. 213 77	277 123

1	2	3	4
	I have missed first division by a few marks. No student in the Zoology department has obtained first division and stand first in the University. I had first class in the honours subject, but why does my university awards division on the total of honours and subsidiary subjects when another university awards it on the honours subject only.	(Number student 7)	89 106 264
7.	**Doubt of Unfair Marking**		
	The examiner in practicals at my centre was unduly hard and all candidates got very low marks in practicals here. I doubt unfair marking of my answer-scripts—my attempt at the examinations was much better.	239 (III) (Number of students : 2)	166

NOTE : (1) Following abbreviations have been used in the above table for indicating the results of the students in the University examinations. This indication is given against their ranks. Where no indication has been given the concerned student has obtained I or II division which is obvious from the context.

(i) III means third division.

(ii) C means compartment.

(iii) D means dropped from the examination.

(2) Description under a particular category of response in the above table has been compiled from the replies of all the students in that category. Thus any particular student owns only a part of that description.

TABLE (2)

DISTRIBUTION OF AWARDEES AMONG VARIOUS RANKS IN THE NATIONAL SCIENCE TALENT SEARCH EXAMINATION

Ranks	No. of awardees in B.Sc. III Year			No. of drop-outs in different ranks of 1964-Batch only	No. of drop-outs who replied the questionnaires	No. of Students who lost first division out of 42 drop-outs who replied
	1964-	1965-	Total			
2-50	25	23	48	10	2	1
51-100	14	26	40	5	9	8
101-150	17	20	37	8	6	5
151-200	24	24	48	12	8	8
200-250	17	19	36	11	7	6
251-300	22	25	47	12	8	7
300-	24	14	38	9	2	2
Total	143	151	294	67	42	37

Note : Information regarding drop-outs of 1965 batch can be finalised only at the end of the year 1968-69.

APPENDIX : (A)

NATIONAL INSTITUTE OF EDUCATION
National Council Of Educational Research & Training
NIE Bldgs, Mehrauli Road,
NEW DELHI-16.

PROFORMA

1. NAME ____

2. Division in B.Sc. (Final exam.) ______________________.
   Please attatch a copy of the Mark-sheet.

Course of study/Employment you are persuing at present ;

____

____

4. Institution where you are studying/working :

____

____

5. Under what circumstances you were compelled to give up the N.S.T.S. Scholarship :

____

____

____

____

____

6. In case you were compelled to give up N.S.T.S. Scholarship on account of not having obtained a first division, do you have some explanation to give regarding why you could not get first division, if so, please state it :

____

____

____

____

____

A STUDY OF FACILITIES POSSESSED BY OR DIFFICULTIES FACED BY N.S.T.S. AWARDEES

QUESTIONNAIRE

Note : (i) Please try to answer within the space provided in this questionnaire. However if the space is not enough, attach a spare sheet of paper and continue your answer on it referring to the concerned question by its serial number.

(ii) Please try to answer frankly to enable this Department to plan the future programmes in such a way that they are more beneficial to you. The information provided by you will be kept confidential and any information will not be used for any purpose other than intended for this particular study.

1. NAME ________________

2. (i) Year of Selection : 1964/1965.

   (ii) School/College where you studied in the year of selection ________________

   ____

3. Institution where you are studying now ________________

   ____

3. Class and major subject of study ________________

5. Whether residing at home or in a hostel ________________

6. Percentage of mark in your examinations. (If in an examination you were tested only for the subject that you have in M.Sc., mark "X" in the column of aggregate percentage for that examination.)

Examination	*% in the particular subject that you have in M.Sc.*	*Aggregate %*
(i) P.U.C./Intermediate/ Hr. Sec./I. Sc./etc.	______	______
(ii) B.Sc. I-year	______	______
(iii) B.Sc. II-Year	______	______
(iv) B.Sc. III-Year	______	______
(v) M.Sc. (Prev.)	______	______
(vi) M.Sc. (Final)	______	______

7. Try to list some of the important facilities you had/have, which were/are conductive for better studies :

   (i) At your home ______________________

   (ii) At your school ______________________

   (iii) At your college/university ______________________

   (vi) In the Hostel where you resided for studies towards a B.Sc./M.Sc. degree :

   ____

8. Try to list some of yous important difficulties which werė/are real obstacles in your way for improving your academic performance :

   (i) At your home ______________________

   (ii) At your school ______________________

   (iii) At your college/university ______________________

   (iv) In the Hostel where you resided for studies towards a B.Sc./M.Sc. degree :

   ____

9. Try to list your special mental capabilities and merit of your method of study which helped you to obtain good examination results and to get an N.S.T.S. award :

   ____

10. Try to list your weaknesses which have been an obstacle in your way for obtaining better examination results and better rank in the N.S.T.S. examination :

11. Try to list efforts made by you/are being made by you to improve your overall academic performance :

(i) For further improving your results in the examination

(ii) For further improving your overall competance as a research worker :

12. State practical problems of an investigatory nature that you have solved during your college carrier. Also state some specific scientific projects and writings you might have undertaking during the period :

(i)

(ii)

(i) Name of your father/Guardian

(ii) Occupation

(iii) Permanent Address

(iv) No. of your brothers and sisters

(v) Total No. of other members in the family

(vi) Monthly income of your family : Rs.

(vii) Number of children below 10 in your family

(viii) Do you have a separate room for your study at home ? Yes/No . If you are now in a hostel, did you have a separate room at your home before joining the hostel ? Yes./No . When did you join Hostel ________.

(ix) Describe if there is/was any noisy activity in your locality which disturbed/disturbs your studies :

(a) At School level ______________________

____

(b) At college/university level ______________________

____

(x) Name, relation and & qualifications of the person, if any in your family who has obtained B.Sc./M.Sc./Ph.D. degree in Science before you obtained the B.Sc. Degree :

____

____

____

Did he help you in your studies in B.Sc. ? ______________________

____

14. Cost and the number of books on scientific topics that you have purchased during your B.Sc./M.Sc. You can include the books you have yourself purchased from your book-grant, but not those which were first purchased by the Department of Science Education and then sent to you during previous years :

(i) Books directly related to your studies :

Cost Rs. __________ Number of Books __________.

(ii) Books not directly related to your studies :

Cost Rs. __________ Number of Books __________.

15. Who was/is your teacher during school/university career whom you like best ?

(i) Name ______________________

(ii) Class (es) in which he/she taught ______________________

____

(iii) Subject he/she taught you ______________________

____

(iv) Try to list out the merit, as objectively as possible, due to which you like him/her

____

____

____

____

16. Give the following particulars in respect in your class-fellow whom you consider as the overall best student in your class.

(i) Name ______________________

(ii) His percentage of marks in B.Sc. ______________________

(iii) Is he/she a N.S.T.S. awardee ______________________

(iv) Do you occassionally get some help from him/her in your studies ?

(v) Try to list out his merits due to which you consider him to be so :

17. Give the following particulars in respect of your fast friend in your class :

(i) Name

(ii) His/her percentage of marks in B.Sc.

(iii) Do you occasionally get some help from him/her or you give help in your/his or her studies ?

(iv) Try to list out his/her merit due to which you have close friendship with him/her :

18. What is the rough distribution of time you used to devote/are devoting over academic studies, extramural activities, sports, reading scientific periodicals and books etc. :

1. At school stage

2. At college stage

19. What are your specific leisure time activities ?

1.
2.
3.

20. What is your vocational goals, in order of preference ?

1.
2.
3.

21. Have you any occupational information about S. No. 20 ?

22. Do you intend to go abroad for studies ? If so, at what stage ?

23. What are are the expectation of your parents from you regarding your future vocational career ?

34. What is the total amount of salary you expect to get on your initial appointment ?

(The End)

STUDY-2

A CORRELATIVE STUDY BETWEEN THE SCORES OBTAINED ON THE SCIENCE APTITUDE TEST (1967) AND THE PROGRESSIVE MATRICES TEST (J.C. RAVEN)

Dr. K. N. Saxena and Sri Pushpendra Kumar

The Science Aptitude Test is one of the most important tools for the identification of talented students under the National Science Talent Scheme. The test contains objective type items on 14 different branches of science, viz,. Physics, Chemistry, Biology, Mathematics, Agriculture, Geology, Philosophy of Science, Physiology and Hygiene, Engineering, Meteorology, Bio-Chemistry, Astronomy and Bio-Physics. This test has been so designed as to measure the powers of comprehension, reasoning, critical thinking and analysis-synthesis rather than mere factual knowledge.

In order to observe upto what extent the Science Aptitude Test assesses a person's capacity for observations and clear thinking, and the power to perform comparisons and the development of reason by analogy (which are measured by Progressive Matrices Test was administered (J C. Raven) alongwith the Science Aptitude Test to 185 students selected from two Higher Secondary schools of Delhi viz., Lady Irwin Higher Secondary school and M.E.A. Higher Secondary School.

The product-moment correlation, based on raw scores, has been found to be 0.39 which is significant at 1% level of significance. It means that the Science Aptitude Test also measures the abilities and powers of clear perception to some extent. The obtained correlation is not as high as 0.7 or 0.8 because the Aptitude Test also measures specific and analytical knowledge of the students in different branches of basic sciences alogwith abilities related to general mental capacity.

The bivariate frequency distribution of scores on both the tests is given below which will be useful to the research workers engaged in the problems of mental measurement and science education. It may be observed that the distribution of scores on the Science Aptitude Test is approximately normal and of the scores on the Progressive Matrices is moderately normal.

	Class Interval	0—10	11—20	21—30	31—40	41—50	51—60	Total
		Progressive Matrices						
Science Aptitude Test	20—35	—	1	—	—	5	1	7
	36—50	1	6	—	1	4	2	14
	51—65	1	2	5	11	22	8	49
	66—80	—	—	—	2	32	12	46
	81—95	—	—	—	6	27	22	55
	96—110	—	—	—	—	10	4	14
	Total	2	9	5	20	100	49	185

STUDY—3

A STUDY REGARDING THE INITIAL CUT-OFF POINT, USED AT THE PRECEDING YEAR OF ELIGIBILITY, AS AN INITIAL SCREENING DEVICE FOR THE NATIONAL SCIENCE TALENT SEARCH EXAMINATION

Dr. K. N. Saxena and Sri Pushpendra Kumar

A representative sample of 319 scholars, studying in XIth class, was selected from the following five Higher Secondary Schools of Delhi :

1. M.E.A Hr. Sec. School, Lodi Estate, New Delhi.
2. Lady Irwin Higher Secondary School, Canning Road, New Delhi.
3. Government Girls Higher Secondary School, Kalkaji, New Delhi.
4. Government Boys Higher Secondary School, Kidwai Nagar, N. Delhi
5. D.A.V. Higher Secondary School, Daryaganj, Delhi.

The Science Aptitude Test (S.A.T.) of 1967 was administered to these students and the Xth class examination marks of science subjects of these scholars were collected from the school records and these were then converted into percentages. S.A.T. booklets were scored by making the correction for guessing factor. The students on the basis of their examination marks on science subjects secured in Xth class, have been classified into seven groups and accordingly the S.A.T. scores of students of each group have been given in table 1.

It has been observed from the experience of the previous years that the selection ratio in the final award of scholarship has remained approximately as 1 : 20, i.e. one student is selected for the final award of scholarship amongst the 20 who appear at the N.S.T.S. examination. According to this selection ratio, we ought to select 16 students, in order of merit, on the basis of the scores obtained on S.A.T., from this sample, irrespective of the science subject marks secured in class X. It can be seen from table 2 that there are 17 students whose test scores are more than 88 (out of 125) and all of these 17 students belong to the group whose examination marks are above 55%. This means that no student whose scholastic marks in science subjects is less than 55% could secure more than 88 marks in the Science Aptitude Test. Hence the probability of the selection of a student whose examination marks are less than 55% is quite low for the final award of scholarship.

In table 2 the mean, variance of the S.A.T. scores for the seven groups of students have been given. The average group performance of students have been tested against the control group which constitutes of students having their examination marks between 55% to 60%. The differences between the average performance of the control group and any other group are highly significant except in case of group comprising of students having the examination marks between 50 to 55%. To be on the safe side, we may lower down the initial

cut-off point from 55% to 50% in the succeeding years though, as shown above the probability of being selected a student for the final award of scholarship from group of students whose examination marks are less than 55% is quite negligible. The lowering down of the initial cut-off point may be necessary if our selection ratio is very low e.g. if we select one student out of the 9 who appear in the N.S.T.S. Examination then we ought to select 35 students in order of merit at the S.A.T. from the sample irrespective of science subject marks secured in class X. The lowest score on S.A.T. of a student amongst these 35 selected ones is 83. It can be seen from Table 2 that out of these 35 students, 33 belong to the group whose obtained marks on science subjects in Xth class are more than 55% and the remaining two students belong to the group comprising of students having the marks between 50 to 55%.

It may be added that this is an extreme hypothetical situation and on the other hand the probable number of students, appearing at the annual tests is increasing progressively every year. Hence, even if we maintain the current cut-off point of 55%, the probability of losing a genuine talent is negligible.

Table 1

10th Class Exam. marks in percentages	Scores (corrected for chance) on Science Aptitude Test—1967.
Less than 40	42, 57, 70, 30, 29, 48, 27, 49, 48, 0, 58, 47, 76, 61, 7, 10, 26, 0, 20, 26, 29, 42, 11, 60, 39, 0, 8, 42, 34, 11, 18, 8, 14, 34, 57, 56, 62, 50, 48, 41, 46, 52, 58, 62, 14, 16, 20, 4, 54, 53, 0, 5, 15, 32, 40, 12, 24,
40—45	69, 43, 41, 10, 27, 42, 42, 68, 43, 31, 58, 62, 52, 29, 68, 62, 27, 13, 55, 74, 59, 49, 50, 64, 46, 53, 34, 21, 82, 38, 11, 32, 49, 58, 58, 61, 57. 58, 60, 0, 0, 19, 22, 22, 36, 6, 17, 8, 22, 27,
45—50	58, 29, 18, 35, 19, 36, 43. 31, 54, 53, 64, 78, 82, 68, 75, 13, 8, 48, 17, 45, 54, 24, 65, 61, 61, 45, 39, 26, 70, 69, 53, 24, 30, 42, 21, 40, 42, 62, 48, 60, 61, 66, 72, 61, 58, 62, 58, 5, 13. 26, 39, 22, 16,
50—55	65, 64, 31, 38, 72, 64, 30, 48, 73, 87, 83, 56, 64, 46, 19, 65, 14, 53, 77, 82, 87, 69, 68, 77, 75, 64, 38, 68, 76, 56, 71, 81, 10, 37, 69, 49, 66, 2, 9, 12, 16, 31, 27, 26,
55—60	53, 50, 37, 86, 56, 90, 64, 41, 65, 73, 85, 42, 22, 43, 83, 66, 68, 42, 49, 49, 46, 33, 54, 46, 61, 63, 77, 83, 65, 52, 62, 73, 23, 19. 20, 33, 39, 30,
60—65	8, 47, 61, 45, 53, 100, 68, 78, 85, 61, 42, 81, 75, 75, 101, 85, 82, 87, 82, 77, 70, 77, 58, 41, 50, 52, 29, 29,
above 65	58, 54, 90, 98, 82, 83, 51, 67, 83, 79, 86, 91, 90, 82. 92. 48, 87, 75, 63, 70, 77, 84, 78, 70, 90, 95, 86, 88, 73, 70, 88, 109, 49, 49, 89, 76, 77, 94, 90, 81, 35, 45, 50, 101, 84, 78, 33, 79, 76,

TABLE 2

(SHOWING GROUPWISE AVERAGE PERFORMANCE OF STUDENTS)

SCIENCE APTITUDE TEST—1967

10th Class Examination Marks in 7%	N	Number of students whose scores on SAT are more than 88	Number of students whose scores on SAT are more than 83	Mean	Variance	S.E. of the mean difference betweed control group, 55-60, and the group Tested	Z
Less than 40	57	0	0	33.37	430.02	4.20	4.91**
40—45	50	0	0	40.58	423.76	4.31	3.11**
45—50	53	0	0	44.70	403.40	4.21	2.21*
50—55	44	0	2	52.41	606.19	4.88	0.33
55—60	38	1	5	54.00	382.74	—	—
60—65	28	2	5	64.11	496.09	5.27	1.92*
Above 65	49	14	23	77.00	275.96	3.96	5.81**
Total	319	17	35				

*Significant at 5% level on one tailed test.

**Significant 1% level on one tailed test.

STUDY-4

A RESEARCH STUDY OF THE DIFFICULTY LEVEL OF THE DIFFERENT PARTS OF THE TEST

Dr. K.N. Saxena
Shri S.K. Batra

Problem :

To study whether the four optional parts (viz Physics, Chemistry, Mathematics, Biology) of the Science Aptitude Test are equally difficult in respect of Test (i.e. are they parallel portions of the tests ?)

Definition :

Two or more tests are said to be statistically parallel when the average scores, dispersion of scores and their lengths are equal.

A Brief Description about S. A. T.

The Science Aptitude Test consists of two parts, Part A & Part B. Part A of the test consists of 75 multiple choice questions of thought type on 14 branches of Sciences and applied sciences (Physics, Chemistry, .Mathematics, Botony, Zoology, History and Philosophy of Science, Bio-Chemistry, Bio-Physics Physiology and Hygiene, Astronomy, Geology, Meteorology, Agriculture and Engineering).

Part B of the test consists of four optional parts, out of which the examinee can take up any one e.g. Physics, Chemistry, mathematics and Biology. Each consists of 50 multiple choice questions, out of which 20 are of thought type and 30 of factual type. The entire test is of 125 marks.

To study the problem under consideration satistically, a sample of 563 examinees was selected out of the total 6159 examinees. The sampling technique followed is stratified simple random sampling with proportional allocation amongst different stratas of the population. The score scale on S.A.T. was divided i.e. 0 (min.) to 125 (Max.) into suitable class-intervals of size 10 and the number of examinees in each class-interval of the population were recorded for forming the different stratas and a sample of size 10% was drawn from each strata.

Thus out of the sample of size 563 drawn in the fashion described above, it was found that 186 students have attempted physics, 193 students have attempted chemistry 51 students have attempted Mathematics and 133 students, the Biology as their optional part of the S.A.T. The part A of the Test is compulsory for every one. For every examinee, the uncorrected scores were recorded on the compulsory part as well as on the optional part which he/she

had attempted. Thereby, in all, we had 563 pairs of value represented in Table (A). The correlational figures for each of the respective optional part of the test is also given in table A. One of these values is designated as a supplementary measure, X. which is not itself of experimental interest (i.e. uncorrected score on the compulsory part of the Test) and to the other by the Y (i.e. uncorrected socre on the optional part of the test) which is of experimental interest. It is the significance of the difference between the average score for the various opitional part of the test that is of interest. The statistical tool suggested for the study is "ANALYSIS OF COVARIANCE FOR A RANDOMIZED GROUP DESIGN". A summary of the covariance—analysis of the data of the Table (A) is represented in Table (B).

A perusal of colum 9 of the table (B), giving the correlational figures representing the degree of association between the uncorrected scores on the compulsory as well as on each of the optional part of the test, gives a general impession that a student scoring high in the compulsory part is likely to do well in the optional parts too. But the degrees of his achievement in each of the optional part will of course be different, which is least in case of mathematics. F=66.0 at (1 & 559) d. f. which is highly significant, shows that there is a significant positive correlation between uncorrected scores in the compulsory and optional part of the test apart from the factors of classification (i.e. these are different optional parts of the test).

Column 13 of the table (B) indicates F= 61.69 which is highly significant, meaning thereby that there is a strong evidence against our nul hypothesis that the four optional parts of the test are satistically parallel. The group means differ significantly after being adjusted for the X values or in other words the average uncorrected score on different optional parts of the test differ significantly after they have been corrected for the difference in the uncorrected scores on the compulsory part of the test. Hence we conclude that the score on the optional part of the test, after corrected for the score on the compulsory part of the test, vary significantly i.e. they are not parallel portion of the tests.

TABLE A

FOR PHYSICS ATTEMPTED AS THE OPTIONAL PART AT THE TEST

x :—Uncorrected score in the compulsory part of the test.

y :—Uncorrected score in the optional part of the test.

S.No.	x	y	Sl. No.	x	y
1.	56	32	28.	52	29
2.	58	32	29.	54	26
3.	55	34	30.	53	25
4.	53	35	31.	49	30
5.	61	29	32.	51	28
6.	61	33	33.	54	22
7.	63	31	34.	42	28
8.	64	33	35.	48	27
9.	64	34	36.	48	29
10.	53	36	37.	54	23
11.	63	40	38.	54	21
12.	69	36	39.	40	24
13.	64	40	40.	53	20
14.	65	40	41.	52	22
15.	63	42	42.	48	21
16.	70	38	43.	49	26
17.	69	45	44.	49	27
18.	68	47	45.	51	23
19.	72	47	46.	43	26
20.	51	36	47.	49	22
21.	56	31	48.	54	17
22.	53	31	49.	38	27
23.	52	31	50.	47	22
24.	52	31	51.	42	21
25.	51	28	52.	52	13
26.	60	23	53.	48	23
27.	51	30	54.	50	21

Sl. No.	x	y
55.	53	11
56.	50	23
57.	58	14
58.	50	22
59.	41	29
60.	45	25
61.	53	11
62.	28	17
63.	39	20
64.	37	22
65.	35	26
66.	36	24
67.	40	19
68.	34	19
69.	40	19
70.	42	18
71.	41	18
72.	41	18
73.	35	21
74.	55	40
75.	42	19
76.	46	17
77.	42	21
78.	43	8
79.	41	20
80.	35	27
81.	38	23
82.	40	23
83.	41	21
84.	44	21
85.	45	20
86.	37	26
87.	48	22
88.	42	24
89.	41	19
90.	48	16
91.	31	26
92.	39	18
93.	42	23
94.	29	25
95.	24	29
96.	49	16
97.	47	18
98.	31	28
99.	41	24
100.	44	23
101.	48	20
102.	44	24
103.	18	12
104.	15	15
105.	20	13
106.	26	9
107.	23	13
108.	13	15
109.	22	13
110.	8	6
111.	28	10
112.	23	15
113.	20	18
114.	24	15
115.	24	11
116.	13	17
117.	23	15
118.	31	11
119.	22	12
120.	31	11
121.	23	16
122.	21	10

Sl.No.	x	y	Sl.No.	x	y
123.	25	18	157.	34	17
124.	7	11	158.	25	19
125.	25	17	159.	36	16
126.	27	15	160.	28	15
127.	23	21	161.	13	20
128.	29	15	162.	38	5
129.	16	11	163.	37	18
130.	17	12	164.	35	18
131.	22	17	165.	37	18
132.	23	16	166.	37	17
133.	23	20	167.	41	15
134.	25	16	168.	36	19
135.	29	16	169.	37	19
136.	21	21	170.	37	23
137.	32	15	171.	21	19
138.	30	6	172.	34	22
139.	31	17	173.	36	21
140.	31	16	174.	29	16
141.	27	19	175.	29	23
142.	26	24	176.	38	19
143.	36	13	177.	33	19
144.	23	19	178.	42	15
145.	35	15	179.	41	25
146.	37	13	180.	28	15
147.	22	23	181.	36	20
148.	21	15	182.	37	21
149.	30	19	183.	41	18
150	29	21	184.	35	22
151.	33	21	185.	32	16
152.	34	17	186.	38	20
153.	40	13		$186 = N_1$	$186 = N_1$
154.	36	16	Total Sum	7329	3980
155.	32	21	Sum of Squares	322567	96196
156.	35	19		$\Sigma XY = 170494$	

$r = 0.71$

Highly significant at 5% level.

TABLE (A)

FOR BIOLOGY ATTEMPTED AS THE OPTIONAL PART OF THE TEST

S. No.	x	y	S. No.	x	y
1.	19	15	33.	32	31
2.	23	14	34.	39	25
3.	21	13	35.	31	25
4.	28	13	36.	39	26
5.	16	10	37.	38	28
6.	20	23	38.	34	30
7.	23	19	39.	41	25
8.	24	21	40.	38	22
9.	36	8	41.	38	25
10.	24	20	42.	35	26
11.	30	18	43.	40	25
12.	27	20	44.	36	31
13.	30	18	45.	44	21
14.	30	19	46.	42	20
15.	19	21	47.	49	22
16.	32	19	48.	45	26
17.	28	25	49.	35	23
18.	31	22	50.	43	23
19.	39	14	51.	45	26
20.	34	18	52.	42	31
21.	32	24	53.	43	31
22.	35	21	54.	48	28
23.	22	21	55.	43	32
24.	30	26	56.	48	29
25.	31	24	57.	51	27
26.	34	21	58.	45	34
27.	35	24	59.	47	30
28.	33	26	60.	50	30
29.	37	33	61.	49	27
30.	32	29	62.	50	32
31.	37	26	63.	50	28
32.	39	26	64.	50	31

S.No.	x	y	S.No.	x	y
65.	15	23	99.	55	40
66.	53	33	100.	61	39
67.	54	37	101,	65	40
68.	51	40	102.	53	41
69.	58	34	103.	59	37
70.	57	37	104.	59	39
71.	57	35	105.	54	39
72.	56	41	106.	58	35
73.	57	39	107.	54	35
74.	58	37	108.	57	43
75.	56	40	109.	54	38
76.	61	41	110.	55	40
77.	64	40	111.	56	41
78.	65	40	112.	54	41
79.	66	41	113.	59	43
80.	65	42	114.	55	29
81.	66	42	115.	45	33
82.	67	44	116.	39	40
83.	69	45	117.	35	28
84.	66	48	118.	37	19
85.	52	30	119.	25	21
86.	49	34	120.	19	17
87.	50	33	121.	54	40
88.	53	34	122.	52	44
89.	52	33	123.	59	38
90.	56	34	124.	61	38
91.	49	37	125.	60	37
92.	56	30	126,	58	43
93.	64	40	127.	60	45
94.	64	44	128.	64	41
95.	62	44	129,	58	47
96.	62	31	130.	61	45
97.	59	44	131.	67	46
98.	58	30	132.	66	46

133.	69	46
	$133 = N_3$	$133 = N_4$
Total Sum	6181	4147
Sum of Squares	312119	139977

$\Sigma XY = 206758.$

$r = 0.86$

Highly significant at 5% levo

FOR CHEMISTRY ATTEMPTED AS OPTIONAL PART OF THE TEST

S. No.	x	y	S. No.	x	y
1.	62	31	35.	20	17
2.	60	35	36.	19	18
3.	49	43	37.	26	13
4.	61	34	38.	25	14
5.	63	35	39.	19	16
6.	62	35	40.	27	14
7,	59	39	41.	20	18
8.	57	42	42.	24	17
9.	58	40	43.	33	18
10.	64	37	44.	27	15
11.	59	41	45.	10	18
12.	63	40	46.	26	16
13.	64	39	47.	30	14
14.	62	45	48.	25	20
15.	64	43	49-	29	14
16.	64	45	50.	14	23
17.	55	33	51.	29	14
18.	67	45	52.	22	20
19.	67	45	53.	27	17
20.	67	48	54,	30	15
21.	22	11	55.	30	15
22.	11	13	56.	27	18
23.	24	12	57.	28	19
24.	19	18	58.	27	17
25.	21	15	59.	13	22
26.	15	12	60.	30	15
27.	12	15	61.	32	12
28.	18	18	62.	23	20
29.	20	15	63.	23	23
30.	21	13	64.	23	24
31.	19	17	65.	23	25
32.	19	18	66.	28	20
33.	18	18	67.	21	21
34,	17	21	68,	32	17

S.No.	x	y	S.No.	x	y
69.	30	19	103.	22	22
70.	29	6	104.	41	20
71.	29	20	105.	45	9
72.	29	21	106.	39	25
73.	25	20	107.	39	25
74.	22	20	108.	35	29
75.	35	15	109.	41	23
76.	31	21	110.	37	27
77.	21	22	111.	39	25
78.	20	22	112.	41	25
79.	35	9	113.	36	30
80.	20	20	114.	36	37
81.	9	28	115.	41	25
82.	31	19	116.	40	26
83.	33	20	117.	45	26
84.	28	18	118.	32	34
85.	23	23	119.	37	27
86.	28	21	120.	35	32
87.	26	22	121.	35	28
88.	37	21	122.	41	25
89.	32	26	123.	40	28
90.	27	26	124.	36	32
91.	37	21	125.	41	27
92.	34	24	126.	38	30
93.	33	25	127.	39	29
94.	48	14	128.	33	30
95.	43	14	129.	33	35
96.	33	26	130.	29	30
97.	31	28	131.	43	28
98.	28	26	132.	48	24
99.	16	29	133.	46	23
100.	35	25	134.	47	27
101.	40	19	135.	28	23
102.	32	28	136.	39	35

S.No.	x	y	S.No.	x	y
137.	43	29	166.	43	34
138.	45	25	167.	42	34
139.	49	26	168.	50	30
140.	47	28	169.	56	32
141.	49	26	170.	49	31
142.	56	12	171.	53	32
143.	39	36	172.	50	34
144.	37	37	173.	54	32
145.	54	24	174.	51	34
146.	48	30	175.	49	38
147.	49	29	176.	46	38
148.	45	33	177.	55	33
149.	52	24	178.	52	36
150.	52	28	179.	52	36
151.	35	40	180.	59	28
152,	42	32	181.	42	44
153.	49	31	182.	55	34
154.	45	34	183.	51	38
155.	47	33	184.	53	35
156.	46	32	185.	53	40
157.	46	33	186.	57	33
158.	46	32	187.	54	35
159.	51	30	188.	55	37
160.	51	30	189.	55	35
161.	43	34	190.	53	36
162.	52	30	191.	55	40
163.	49	33	192.	55	39
164.	46	31	193.	53	40
165,	45	37			

$193 = N_2$ $\qquad$ $193 = N_2$

$\Sigma X = 7435$ $\qquad$ $\Sigma Y = 5114$

$\Sigma X^2 = 323389$ $\qquad$ $MY^2 = 150714$

$\Sigma XY = 214494.$

$r = 0.74$

Highly significant at 5 % level.

FOR MATHEMATICS ATTEMPTED AS THE OPTIONAL PART OF THE TEST

S.No.	X	Y	S.No.	X	Y
1.	15	10	27.	31	15
2.	22	14	28.	38	9
3.	4	14	29.	28	20
4.	21	15	30.	28	18
5.	21	8	31.	24	16
6.	25	11	32.	23	14
7.	6	9	33.	35	15
8.	20	16	34.	35	15
9.	25	13	35.	34	18
10.	16	1	36.	30	3
11.	24	14	37.	31	13
12.	22	13	38.	32	19
13.	21	18	39.	14	17
14.	23	15	40.	41	14
15.	25	14	41.	40	15
16.	16	12	42.	34	23
17.	27	10	43.	30	16
18.	28	13	44.	40	9
19.	27	7	45.	44	10
20.	23	18	46.	50	3
21.	23	12	47.	56	16
22.	30	14	48.	54	19
23.	32	11	49.	52	32
24.	23	22	50.	66	21
25.	34	6	51.	64	30
26.	21	24			

$51 = N_s$

$\Sigma X = 1529$ $\Sigma Y = 734$

$MX^2 = 54261$ $MY^2 = 12324$

$\Sigma XY = 23229$

$r = 0.32$

Significant at 5% level.

TABLE (B)

SUMMARY OF THE COVARIANCE ANALYSIS OF THE DATA

S.No.	Source of variation	Size	Sum of Squares ΣX^2	ΣY^2	Product-Sum ΣXY	Ave. score on compulsory part	Reg. Coef.	r	S.S.	D.F.	M.S.	F
1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Physics Group	186	33,780.76	11,026.56	13,669.17	39.40	0·40	0.708				
2.	Chemistry Group	193	38,444.55	15,905.00	18,501.20	29.98	0.8	0.748				
3.	Mathematics Group	51	8,421.00	1,760.16	1,223.40	38.32	0.45	0.317				
4.	Biology Group	133	24,865.16	10,671,67	14,031.64	46 47	0.56	0.861				
5.	Between Groups	...	11,291.42	13,563.91	10,680.53				5974.67	3	1991.6	61.69**
6.	Within Groups (Error)		1,05,511.47	39,363.39	47,425.41			0.735	1,8046.57	559	32.28	
7.	Total	563	1,16,802.89	52,927.30	58,105.04				2,4021.34	562	42.74	

$$F_{(1, N-K-1)} = \frac{[(\Sigma XYw)^2/\Sigma Xw^2](N-K-1)}{\Sigma Y^2w-(\Sigma XYw)^2/\Sigma X^2w} = 1.18 \times 559 = 660$$ highly significant.

The best estimate of the population regression coefficient bw=0.449

regression coefficient based upon the total product sum and total sum of squares on the X variable is bt=0.946

PROJECT-5

Problem.

Dr. K. N. Saxena
Sri S. K. Batra

To study the effect on the reliability of the Science Aptitude Test (year 1967) by discarding the items of low discriminative power.

Solution :—For the aforesaid study five Higher Secondary schools listed below were selected at random :

(i) Lady Irwin Higher Secondary School for Girls, New Delhi.
(ii) M.E.A. Higher Secondary School, Lodhi Estate, New Delhi.
(iii) D.A.V. Higher Secondary School, Darya Ganj, New Delhi.
(iv) Government Girls Higher Secondary School, 2nd Shift, Sarojini Nagar, New Delhi.
(v) Government Boys Higher Secondary School, Kalkaji, New Delhi.

The test was administered (discarding the items of low discriminating power based on the item analysis of the items set in the science Aptitude Test administered to the examinees in year 1967), to three hundred students studying in the final year of the Higher Secondary Courses and scoring more than 55% of the marks in Physis, Chemistry, Biology and Mathematics in aggregate at class X or equivalent. No time limit was put on the test i.e. the test was a Power test, and not partially speeded rest as before. It was that the maximum time taken by the students was 180 minutes.

Following items of the S.A.T, were selected for the restest proced- ure : –

Compulsory Part

Items No :—1 to 12, 14 to 21, 24, 26, 29 to 34, 36 to 50, 52 to 59, 61, 63 to 67 71 to 73 and 75.

Optional Parts

Physics

Items No :—1 to 11, 13, 15, 18, 19, 23, 25, 27 to 37, 39, 43 to 50

Chemistry

Items Nos :—3, 5, 7, to 23, 25, 27 to 39, 41 to 46, 49 and 50

Biology

Items No :—3, 6, 8, 9, 12, 15 to 18, 20, 21, 23, to 29, 31 to 33, 35, 41, 44 to 50.

The reliability of the Science Aptitude Test has been worked out by Kuder Richardson formula (KR-20) which gives the internal consistency of the test

items and thus the dependability of the test scores. In a way. it is the self correlation of a test, that is, the correlation of a test with itself. It provides indirectly an estimate of the error of measurement of the test Scores. Since all the conditions for K-R formula are not fulfilled in our case, the estimates obtained may be on the high side or low side, therefore no much weightage is to be given to the estimates. For the compulsory part of the test (after discarding the items of low discriminative power) the figure comes out to be $r_{11}=0.89$.

For the optional parts of the Test, (after discarding the items of low discriminating power) the reliability coefficients are

(i) Physics $r_{11}=0.83$)
(ii) Chemistry $r_{11}=0\ 83$) (A)
(iii) Biology $r_{11}=0.72$)

In case of mathematics, the figure has not been worked out due to lakc of data. Because very few students have attempted this optional part of the test and that too with little attention.

It has has been observed from the examination of the previous years that the % age of examinees going in for mathematics as the optional part of the test is very small in comparison to the preferences for the other parts. The same is true is case of opting the Hons. course in Mathematics by the finally selected awardees.

This year the figures have been worked out as :

Optional Part	*%age of students*
(1) Physics	35%
(2) Chemistry	31%
(3) Biology	26%
(4) Mathematics	8%

Mathematical Olympiads have been stated since 1968 to encourage student to opt for studies mathematics.

Moreover, it has been observed from the examinations of previous years that the reliability coefficient for mathematics is throughout very low in comparison to the reliability coefficient for the other parts of the test. A perusal of the following table will revead the validitp of the aforesaid statements.

Reliability coefficients of the Science Aptitude Test set in various years.

	Year 1964	*Year 1965*	*Year 1966*	*Year 1967*
Compulsory Part	$r_{11}=0.90$	$r_{11}=0.91$	$r_{11}=0.89$	$r_{11}=0.92$
Optional Part				
(i) Physics—	$r_{11}=0.85$	$r_{11}=0.83$		$r_{11}=0.86$
(ii) Chemistry*—	$r_{11}=0.85$	$r_{11}=0.86$		$r_{11}=0.88$
(iii) Biology		$r_{11}=0.83$	$r_{11}=0.82$	$r_{11}=0.89$
(iv) Mathematics*		$r_{11}=074$	$r_{11}=0.72$	$r_{11}=0.72$

*—No.'optional part was given in year 1964.

A perusal at the figures at (A) reveals that the reliability figures havegone down in comparison to that of year 1967, when no items were discarded. The this decreases in the length of the test may be one of the important reosons for decrease, further non-seriousness of the students while take the test may be another reason.

Since some of the assumptions involved in carrying out of the item analysis are not fulfilled it may be possible that the item analysis contained in the S.A.T, may not be perfect, which may be considered as the third plausible reason.

A different result may be expected if the spearman-Brown formula for determining the reliability of the test may be applied to the shortened test.

RAW DATA OF THE COMPULSORY PART OF THE TEST

(SAMPLE SIZE—200)

S. No.	No. of students passing at the item	No. of students failing at the item	p=proportion passing at the item	q=proportion failing at the item
1.	140	60	0.07	0.30
2.	112	88	0.55	0.44
3.	120	80	0.60	0.40
4.	119	81	0.595	0.405
5.	55	145	0.275	0.725
6.	155	45	0.775	0.225
7.	148	52	0.74	0.26
8.	147	53	0.735	0.265
9.	138	62	0.69	0.31
10.	117	83	0,585	0.415
11.	93	107	0.465	0.535
12.	128	72	0.64	0.36
14.	107	93	0.535	0.465
15.	136	64	0.68	0.32
16.	148	52	0.74	0.26
17.	133	67	0.665	0.335
18.	154	46	0.77	0.23
19.	133	67	0.665	0.335
20.	135	65	0.675	0.325
21.	67	133	0 335	0.665
24.	141	59	0.705	0.295
26.	85	115	0.425	0.575
29.	106	94	0.53	0.470
30.	63	137	0.315	0.685
31.	110	90	0.55	0.45
32.	182	18	0.91	0.09
33.	126	74	0.63	0.37
34.	89	111	0.445	0 555
36.	154	46	0.77	0.23
37.	169	31	0.845	0.155
38.	128	72	0.64	0.36
39.	150	50	0.75	0.25
40.	154	46	0.77	0.23
41.	168	32	0.84	0.16
42.	172	28	0.86	0.14
43.	103	97	0.515	0.485
44.	123	77	0.616	0.385
45.	128	72	0.64	0.36
46.	145	55	0.725	0.275
47.	138	62	0.69	0.31
48.	131	69	0.655	0.345

49.	114	86	0·57	0.43
50.	136	64	0.68	0.32
52.	130	70	0.65	0 35
53.	112	88	0.56	0.44
54.	93	107	0.465	0.535
55.	147	53	0.735	0.265
56.	69	131	0.345	0.655
57.	153	47	0.765	0.235
58.	133	67	0.665	0.335
59.	143	57	0.715	0.285
61.	114	86	0.57	0.43
63.	149	51	0.745	0.225
64.	148	62	0.74	0.26
65.	137	63	0.685	0.315
66.	122	78	0.61	0.39
67.	144	56	0 72	0.28
71.	75	125	0.375	0.625
72.	80	120	0.40	0.60
73.	87	113	0.435	0.565
75.	68	132	0.34	0.66

$\Sigma pq = 13.04$

$$r = \frac{n}{n-1} \times \frac{SDt^2 - \Sigma pq}{SDt_2} = 0\ 89$$

SDt^2 (variance of the test scores) = 106.25

Class intervals	Frequency
10-15	5
15-20	4
20-25	11
25-30	20
30-35	31
35-40	35
40-45	37
45-50	28
50-55	22
55-60	7
	200

Mean = 33.21

RAW DATA OF THE PHYSICS (OPTIONAL) PART OF THE TEST

Item No.	No. of students passing at the Item	No. of students failing at the Item	Proportion of students passing at the Item	Proportion of studants failing at the Item
1.	54	11	.8305	.1691
2.	53	12	.8151	.1845
3.	56	9	.8612	.1384
4.	52	13	.7997	.1994
5.	45	20	.6921	.3076
6.	38	27	.5844	.41526
7.	40	25	.6152	.3145
8.	18	47	.2768	.72286
9.	44	21	.6767	.3229
10.	13	52	.1999	,7997
11.	34	31	.5229	.4767
13.	33	32	.5075	.4921
15.	22	43	.3383	.6613
18.	11	54	.1691	.8305
19.	36	29	.5536	.4460
23.	16	49	.2460	.7536
25.	30	35	.4614	.5383
27.	21	44	.3229	.6767
28.	17	48	.2614	.7382
29.	15	50	.2307	.7690
30.	57	8	.8766	.1230
31.	37	28	.5690	,4309
32.	29	36	.4460	,5536
33.	19	46	.2922	.7074
34.	26	39	.3998	.5998
35.	27	38	.4152	.5844
36.	13	52	.1990	.7997
37.	23	42	.3537	.6459
39.	14	51	.2153	.7843
43.	30	55	.4614	.5383
44.	26	39	.3998	.5998
45.	34	32	.5075	.4921
46.	34	31	.5229	.4767
47.	30	35	.4614	.5383
48.	34	31	.5229	.4767
49.	31	34	.4767	.5229
50.	27	38	.4152	..5844

$\Sigma PQ = 7 \cdot 7382$

$SDt^2 = 40 \cdot 05$

$r = 0 \cdot 83$

RELIABILITY FOR OPTIONAL PART (BIOLOGY) OF THE TEST

S. No. of Item	No. of students passing at the Item	No. of students failing at the Item	% age passing at the Item (P)	% age failing at the Item (Q)
3	54	30	0.6426	0.3570
6	61	23	0.7259	0.2737
8	71	13	0.8449	0.1547
9	64	20	0.7616	0.2380
12	63	21	0.7497	0.2499
15	58	26	0.6902	0.3094
16	40	44	0.4760	0.5236
17	83	1	0.9877	0.0119
18	42	42	0.5000	0.5000
20	53	31	0.6307	0.3689
21	66	18	0.7854	0.2142
23	77	7	0.9163	0.0833
24	68	16	0.8092	0.1904
25	36	48	0.4284	0.5712
26	43	41	0.5117	0.4879
27	60	24	0.7140	0.2856
28	45	39	0.5355	0.4641
29	60	24	0.7140	0.2858
31	68	16	0.8092	0.1904
32	49	35	0.5831	0.4165
33	60	24	0.7140	0.2856
35	60	24	0.7140	0.2856
41	45	39	0.5355	0.4641
44	51	33	0.6069	0.3927
45	42	42	0.5000	0.5000
46	58	26	0.6902	0.3094
47	63	21	0.7497	0.2499
48	57	27	0.6783	0.3213
49	21	63	0.2499	0.7497
50	36	48	0.4284	0.5712

$\Sigma PQ = 6.0308$

$r = 0.716$

Frequency distribution of scores on Biology Optional Part

Score	Frequency
8	1
10	2
12	2
13	2
14	4
15	4
16	5
17	7

18	7
19	6
20	2
21	9
22	9
23	8
24	4
25	5
26	3
27	3
30	1
	N=84
	Mean=19,69
	Sdt^2=19.59

RAW DATA OF THE CHEMISTRY (OPTIONAL) PART OF THE TEST

Item No.	No. of students passing at the Item	No. of students failing at the Item	P-proportion passing at the Item	Q=proportion failing at the Item
3	45	15	.7497	.2499
5	47	13	.7830	.2165
7	34	26	.5664	.4331
8	34	26	.5664	.4331
9	49	11	.8163	.1832
10	40	20	.6664	.3332
11	33	27	.5497	.4498
12	44	16	.7330	.2665
13	34	26	.5664	.4331
14	23	37	.3831	.6164
15	37	23	.6164	.3331
16	18	41	.3165	.6830
17	29	31	.4831	.5164
18	45	15	.7497	.2499
19	25	35	.4165	.5831
20	49	11	.8163	.1832
21	23	37	.3831	.6164
22	37	23	.6164	.3831
23	41	19	.6830	.3165
25	11	49	.1832	.8163
27	33	27	.5497	.4498
28	24	36	.3998	.5997
29	47	13	.7830	.2105
30	52	8	.8663	.1332
31	53	7	.8829	.1166
32	55	5	.9163	.0833
33	54	6	.8996	.1000
35	37	23	.6164	.3831
36	51	9	.8496	.1500
37	30	30	.5000	.5000
38	38	22	.6330	.3670
39	15	45	.2500	.7500
41	34	26	.5664	.4336
42	33	27	.5497	.4498
43	42	18	.6997	.2998
44	38	22	.6330	.3665
45	46	14	.7663	.2332
46	29	31	.4831	.5164
49	38	22	.6330	.3665
50	49	11	.8163	.1832

r=0.83

$\Sigma PQ=8.0886$
$SDt^2=43.45$

PROJECT—6

Dr. K. N. Saxena
Shri S. K. Batra

Problem :

Role of correction for guessing on the students score belonging to different ability groups.

Design of study :

In order to observe the degree of element of guessing in the low group, top group and the group of selected awardees, a detailed study has been performed on the candidates belonging to the aforesaid groups regarding their corrected scores, uncorrected scores, omissions and wrong responses.

The top group of size 127 consists of 26% from top of the stratified proportional random sample drawn from the entire population of examinees. Thereby the top group covers all these candidates who have a corrected score of 58 and above in the Science Aptitude Test. The bottom group of size 136 consists of all those candidates whose corrected score is upto 30. This comprises the 27% from the bottom of the aforesaid sample. The third group of size 229 consists of all those candidates who were finally selected for the award.

A glance at the statistical figures (i.e. Mean & S.D.) worked out for each group reveals that there is a significant difference between the average number of omissions and average number of wrong responses of the bottom and the top groups. For the top and the selected groups, there is no significant difference between the two groups while taking into consideration the average number of wrong responses.

A perusal of the correlational figures, worked out between the corrected and uncorrected scores for the three aforesaid groups, (which are as follows) :—

(i)	Top group	$r = 0.98$
(ii)	Bottom group	$r = 0.78$
(iii)	Selected group	$r = 0.97$

reveals the general impression that in case of top group, the element of guessing plays an insignificant role, There by suggesting the application of the formula :—

$$S = R - \frac{W}{n-1}.$$

S=Corrected score

R=The number of right answers (uncorrected score)

W=The number of wrong answers

n=total number of alternatives provided to each item.

does not play any vital role. But this does not mean that the element of guessing is completely eliminated. From the detailed study of the enclosed tables, which have been drawn up to observe the attractiveness of various distractors of the multiple choice items of the Science Aptitude Test of year 1967 for the different groups of students classified by the total test score, it is clear that for the high achievers (scoring more than 80 out of 125) the distractors are not equally attractive. Very often, it has been observe that if at all the candidates belonging to the top group face any difficulty in choosing the correct response, his confusion mostly lies only between the two alternatives which is a clearout case of right and wrong response. Keeping in view the above fact, the formula for scoring should be $S = R - \frac{W}{2}$. (where the symbols stand as usual), which will show a significant decrease in corrected scores. For example a candidate whose uncorrected score is 105 and the number of his wrong answers are 20 than the correct score should be 95 not 98.

If we take into consideration only the uncorrected score, or in other words the scores not taking into consideration the guessing factor, then most of the high and low achievers will indulge in blind guessing where they will feel some difficulty in choosing the correct response.

From the correlational figure ($r = 0.78$) worked out for the low group, it is clear that these students indulge in guessing work more than the high achievers. The raw scores reveal that most of the students are scoring more than 50 while the number of their wrong attempts in most of the cases is even much more than that of their raw score. Moreover, in case of multiple choice questions the raw score does not represent the true ability of the candidate but actually it represent to some extent the true ability of guessing in case of low group and approximately true ability in case of top group because of the fact that there is no marked difference between the corrected and uncorrected scores in the top group.

The over all picture is that there is an element of guessing among the students belonging to different groups. While excluding the guessing factor perhaps it will not be possible to make a clear distinction among the students in the following fields :—

(i) his/her aptitude for science,

(ii) his/her interest in pursuing science beyond the routine curriculum,

(iii) his/her powers of scientific reasoning,

(iv) his/her ability to understand scientific concepts precisely,

(v) his/her ability to use the scientific approach in checking hypotheses, in interpreting data and in applying principles, and

(vi) his/her capacity to judge assumptions underlying conclusions.

THE COEFFICIENT OF CORRELATION BETWEEN THE CORRECTED AND UNCORRECTED SCORES OF THE EXAMINEES SCORING TOTAL SCORE 58 AND ABOVE IN SCIENCE APTITUDE TEST (TOP GROUP :— 26% OF THE STRATIFIED PROPORTIONAL SAMPLE DRAWN FROM THE TOTAL POPULATION) SAMPLE SIZE=127

S. No.	Corrected Score	Uncorrected Score	Omitted	Wrong response
1.	98	105	0	20
2.	101	107	0	18
3.	108	112	1	12
4.	110	114	0	12
5.	89	93	0	27
6.	68	78	17	30
7.	68	82	1	42
8.	73	85	4	36
9.	77	89	0	36
10.	83	89	9	27
11.	95	103	0	22
12.	104	109	1	15
13.	78	89	3	33
14.	88	97	1	27
15.	96	105	0	20
16.	108	114	0	14
17.	115	119	0	6
18.	69	83	0	42
19.	80	92	0	33
20.	94	103	0	22
21.	68	77	21	27
22.	69	82	4	39
23.	73	84	8	33
24.	84	94	0	31
25.	77	90	0	35
26.	84	92	9	24
27.	98	107	0	18
28.	93	99	8	18
29.	81	90	8	27
30.	72	85	1	39
31.	69	83	0	42
32.	69	76	28	21
33.	73	86	0	39
34.	86	95	3	27
35.	68	81	5	39
36.	68	13	13	33
37.	67	81	2	42
38.	69	83	0	42
39.	84	94	0	31
40.	84	90	17	18

41.	97	104	0	21
42.	67	81	2	42
43.	71	92	0	33
44.	86	101	0	24
45.	90	106	0	19
46.	83	86	30	9
47.	89	97	4	24
48.	74	90	0	35
49.	79	86	18	21
50.	67	77	18	30
51.	68	92	1	42
52.	66	79	7	39
53.	68	82	1	42
54.	66	81	0	44
55.	66	78	11	36
56.	61	75	8	42
57.	62	76	7	41
58.	62	78	0	47
59.	61	77	0	48
60.	66	76	19	30
61.	65	79	4	42
62.	63	78	2	45
63.	62	70	31	24
64.	64	76	13	36
65.	66	78	11	36
66.	61	77	0	48
67.	63	78	2	45
68.	64	80	0	45
69.	66	81	0	44
70.	65	79	4	42
71.	62	79	0	46
72.	59	75	2	48
73.	59	75	2	48
74.	59	77	0	48
75.	59	73	10	42
76.	59	64	16	45
77.	60	69	29	27
78.	59	68	30	27
79.	60	75	10	45
80.	67	82	0	43
81.	69	83	0	42
82.	72	87	0	38
83.	77	91	0	34
84.	77	89	0	36
85.	82	93	0	32
86.	89	98	0	27
87.	91	98	6	21
88.	108	112	1	12
89.	71	83	6	36
90.	76	89	0	36
91.	74	86	3	36

92	80	90	5	30
93.	92	100	1	24
94.	112	115	0	10
95.	76	88	1	36
96.	71	80	18	27
97.	72	85	1	39
98.	72	84	5	36
99.	74	87	0	38
100.	74	84	11	30
101.	74	84	0	38
102.	76	88	1	36
103.	76	86	9	30
104.	76	88	1	36
105.	77	87	8	30
106.	77	88	4	33
107.	77	86	12	27
108.	79	88	10	27
109.	79	90	2	33
110.	81	91	4	30
111.	85	94	4	27
112.	86	94	7	24
113.	86	87	0	28
114.	87	95	6	24
115.	92	98	9	18
116.	97	104	0	21
117.	98	105	0	20
118.	99	105	0	18
119.	101	107	0	18
120.	101	107	0	18
121.	103	108	2	15
122.	110	114	0	11
123.	112	115	1	9
124.	74	87	0	38
125.	85	92	12	21
126.	92	100	1	24
127.	86	96	0	29
			0	
			I=4.79	$\overline{W}$=30.844
			$\overline{0}$	
			S.D.=7.2	S.D.=10.0

The co-efficient of correlation

F=0.98

Highly Significant at 0.01 level.

41.	97	104	0	21
42.	67	81	2	42
43.	71	92	0	33
44.	86	101	0	24
45.	90	106	0	19
46.	83	86	30	9
47.	89	97	4	24
48.	74	90	0	35
49.	79	86	18	21
50.	67	77	18	30
51.	68	92	1	42
52.	66	79	7	39
53.	68	82	1	42
54.	66	81	0	44
55.	66	78	11	36
56.	61	75	8	42
57.	62	76	7	41
58.	62	78	0	47
59.	61	77	0	48
60.	66	76	19	30
61.	65	79	4	42
62.	63	78	2	45
63.	62	70	31	24
64.	64	76	13	36
65.	66	78	11	36
66.	61	77	0	48
67.	63	78	2	45
68.	64	80	0	45
69.	66	81	0	44
70.	65	79	4	42
71.	62	79	0	46
72.	59	75	2	48
73.	59	75	2	48
74.	59	77	0	48
75.	59	73	10	42
76.	59	64	16	45
77.	60	69	29	27
78.	59	68	30	27
79.	60	75	10	45
80.	67	82	0	43
81.	69	83	0	42
82.	72	87	0	38
83.	77	91	0	34
84.	77	89	0	36
85.	82	93	0	32
86.	89	98	0	27
87.	91	98	6	21
88.	108	112	1	12
89.	71	83	6	36
90.	76	89	0	36
91.	74	86	3	36

92.	80	90	5	30
93.	92	100	1	24
94.	112	115	0	10
95.	76	88	1	36
96.	71	80	18	27
97.	72	85	1	39
98.	72	84	5	36
99.	74	87	0	38
100.	74	84	11	30
101.	74	84	0	38
102.	76	88	1	36
103.	76	86	9	30
104.	76	88	1	36
105.	77	87	8	30
106.	77	88	4	33
107.	77	86	12	27
108.	79	88	10	27
109.	79	90	2	33
110.	81	91	4	30
111.	85	94	4	27
112.	86	94	7	24
113.	86	87	0	28
114.	87	95	6	24
115.	92	98	9	18
116.	97	104	0	21
117.	98	105	0	20
118.	99	105	0	18
119.	101	107	0	18
120.	101	107	0	18
121.	103	108	2	15
122.	110	114	0	11
123.	112	115	1	9
124.	74	87	0	38
125.	85	92	12	21
126.	92	100	1	24
127.	86	96	0	29
			0	
			$\bar{I}=4.79$	$\bar{W}=30.844$
			0	
			S.D.=7.2	S.D.=10.0

The co-efficient of correlation

F=0.98

Highly Significant at 0.01 level.

THE COEFFICIENT OF CORRELATION BETWEEN THE CORRECTED AND UNCORRECTED SCORES OF THE EXAMINEES SCORING TOTAL SCORE UP TO 30 IN SCIENCE APTITUDE TEST (i.e. LOW GROUP 27% OF THE STRATIFIED PROPORTIONAL SAMPLE DRAW FROM THE TOTAL POPULATION OF EXAMINEES)

S. No.	Corrected Score	Uncorrected Score	Omitted	Wrong response
1.	29	52	4	69
2.	25	42	32	51
3.	19	44	6	75
4.	16	41	9	75
5.	15	28	58	39
6.	13	30	8	78
7.	13	41	0	84
8.	10	38	3	84
9.	9	38	6	81
10.	9	36	14	75
11.	8	36	5	84
12.	12	38	9	78
13.	19	44	6	75
14.	19	44	6	75
15.	23	48	2	75
16.	26	50	3	72
17.	29	51	8	66
18.	12	39	5	81
19.	15	31	46	48
20.	22	47	3	75
21.	22	45	11	69
22.	23	33	62	30
23.	27	44	30	51
24.	28	33	77	15
25.	29	52	4	69
26.	27	52	0	73
27.	27	50	6	69
28.	29	53	0	72
29.	11	35	18	72
30.	15	34	34	57
31.	22	48	0	77
32.	28	40	49	36
33.	2	33	0	92
34.	6	36	0	89
35.	7	36	38	87
36.	16	42	5	78
37.	18	45	0	80
38.	18	44	3	78
39.	18	43	7	75

40.	19	45	2	78
41.	20	46	1	78
42.	21	42	20	63
43.	22	46	7	72
44.	23	42	26	57
45.	25	37	52	36
46.	25	50	0	75
47.	25	49	4	72
48.	28	42	41	42
49.	29	53	0	72
50.	29	31	88	6
51.	29	53	0	72
52.	27	50	6	69
53.	27	49	10	66
54.	29	49	16	60
55.	22	47	3	75
56.	29	44	26	45
57.	19	41	18	66
58.	18	43	7	75
59.	14	41	3	81
60.	14	41	3	81
61.	19	35	42	48
62.	9	38	0	87
63.	9	37	4	84
64.	9	17	84	24
65.	8	35	9	81
66.	24	35	57	33
67.	29	50	12	63
68.	24	50	0	75
69.	24	49	1	75
70.	25	50	0	75
71.	25	50	0	75
72.	27	49	10	66
73.	28	51	5	69
74.	30	54	0	71
75.	8	9	114	3
76.	17	44	0	81
77.	18	44	3	78
78.	19	40	22	63
79.	22	36	47	42
80.	23	48	2	75
81.	24	49	1	75
82.	26	50	3	72
83.	23	47	6	72
84.	8	36	5	84
85.	17	43	4	78
86.	17	44	0	81
87.	18	39	23	63
88.	29	53	0	72
89.	29	56	0	69
90.	29	52	4	69

91.	27	36	62	27
92.	26	45	68	57
93.	25	45	20	60
94.	24	49	1	75
95.	24	46	13	66
96.	22	48	0	77
97.	21	40	28	57
98.	17	29	60	36
99.	17	27	68	30
100.	17	42	8	75
101.	16	44	0	75
102.	16	42	5	78
103.	16	35	33	57
104.	16	46	0	79
105.	15	26	66	33
106.	14	42	0	83
107.	14	42	0	83
108.	11	39	2	84
109.	11	42	0	83
110.	11	35	18	72
111.	11	39	2	84
112.	7	34	10	81
113.	3	32	6	87
114.	2	33	42	93
115.	1	30	8	87
116.	0	30	23	72
117.	1	25	28	72
118.	6	18	71	36
119.	6	36	0	89
120.	6	30	0	89
121.	6	36	0	89
122.	6	22	27	69
123.	6	28	31	66
124.	6	25	43	57
125.	7	36	2	87
126.	7	35	6	84
127.	9	37	4	84
128.	9	39	0	87
129.	9	36	8	81
130.	9	36	0	87
131.	10	39	0	86
132.	13	38	12	75
133.	14	28	55	42
134.	15	42	2	81
135.	16	43	1	81
136.	16	18	121	66
			$\bar{O} = 17.0$	$\bar{W} = 68.389$
			$\sigma^2 w = 581.30$	$\sigma^2 w = 342.981$
			S.D. = 24.1	S.D. = 18,5

THE COEFFICIENT OF CORRELATION
$\rho = 0.78$
Significant at 0.01 level.

CORRELATION BETWEEN CORRECTED AND UNCORRECTED SCORES OF THE SELECTED AWARDEES ON THE SCIENCE APTITUDE TEST, YEAR 1967

S.No.	Corrected Score	Uncorrected Score	Omitted	Wrong response
1.	86	96	0	29
2.	97	104	0	21
3.	88	97	1	27
4.	81	91	4	30
5.	115	118	0	7
6.	102	108	2	15
7.	110	114	0	11
8.	112	115	0	10
9.	71	84	2	39
10.	76	88	13	24
11.	89	98	1	26
12.	84	94	1	30
13.	88	97	0	29
14.	98	105	0	20
15.	97	104	0	21
16.	96	103	2	20
17.	84	102	28	23
18.	77	82	0	15
19.	112	115	0	10
20.	114	117	0	8
21.	106	111	0	14
22.	105	110	1	14
23.	102	108	0	17
24.	67	73	34	18
25.	92	100	0	22
26.	80	91	0	34
27.	69	89	1	41
28.	98	104	4	17
29.	92	100	0	25
30.	77	88	3	34
31.	92	100	0	25
32.	24	102	0	23
33.	88	95	8	23
34.	86	96	0	29
35.	93	101	1	25
36.	84	91	13	21
37.	77	89	0	36
38.	81	92	0	33
39.	85	95	0	30
40.	78	90	0	35
41.	86	96	0	29
42.	83	92	5	28
43.	88	97	0	28
44.	84	94	0	31

45.	92	100	9	26
46.	100	106	0	9
47.	95	103	0	22
48.	69	74	36	15
49.	91	100	0	25
50.	100	106	2	17
51.	91	99	2	24
52.	92	100	0	25
55.	77	89	0	36
54.	76	38	0	37
55.	74	87	0	38
56.	64	78	6	41
57.	77	89	0	36
58.	102	108	0	17
59.	99	105	3	17
60.	107	111	2	12
61.	88	97	0	28
62.	97	103	0	21
63.	86	36	0	29
64.	88	96	6	23
65.	72	85	0	40
66.	92	100	0	25
67.	101	107	9	18
68.	88	97	0	28
69.	97	104	9	21
70.	94	101	2	22
71.	110	114	0	11
72.	100	106	1	18
73.	87	96	0	27
74.	97	103	0	22
75.	103	108	2	15
76.	100	106	0	19
77.	94	100	6	19
78.	102	108	0	17
79.	68	81	6	38
80.	115	117	1	7
81.	98	105	0	20
82.	65	79	0	41
83.	86	96	0	29
84.	89	98	2	26
85.	88	97	8	28
86.	84	04	0	31
87.	87	96	3	26
88.	91	97	11	17
89.	87	96	2	27
90.	92	100	0	26
91.	98	105	0	22
92.	98	104	3	18
93.	102	108	0	17
94.	95	101	6	18
95.	74	86	3	36

96.	112	115	0	10
97.	109	112	3	12
98.	109	113	1	11
99.	100	106	0	19
100.	99	105	2	18
101.	99	105	3	17
102.	98	105	0	20
103.	80	89	10	26
104.	72	77	33	15
105.	110	4	10	11
106.	67	73	35	12
107.	90	99	0	26
108	69	83	1	41
109.	81	92	0	33
110.	80	91	1	33
111.	89	96	7	22
112.	84	94	1	50
113.	70	84	0	41
114.	95	102	1	22
115.	100	106	1	18
116.	81	87	21	17
117.	98	105	0	20
118.	112	115	0	10
119.	98	105	0	20
120.	76	88	0	37
121.	94	102	0	23
122,	91	99	2	24
123.	104	108	5	12
124.	93	101	0	24
125.	81	92	-1	22
126.	100	106	0	19
127.	78	90	0	35
128.	92	100	1	24
129.	93	100	4	21
130.	78	90	0	35
131.	79	87	14	24
132.	93	99	7	19
133.	92	100	0	25
134.	67	81	3	41
135.	75	86	7	29
136.	70	84	0	41
137.	95	101	5	19
138.	89	96	7	22
139.	104	109	0	16
140.	82	92	2	31
141.	84	94	0	31
142.	80	89	8	28
143.	63	78	2	45
144.	85	93	8	24
145.	82	90	11	24
146.	75	87	3	25

45.	92	100	9	26
46.	100	106	0	9
47.	95	103	0	22
48.	69	74	36	15
49.	91	100	0	25
50.	100	106	2	17
51.	91	99	2	24
52.	92	100	0	25
55.	77	89	0	36
54.	76	38	0	37
55.	74	87	0	38
56.	64	78	6	41
57.	77	89	0	36
58.	102	108	0	17
59.	99	105	3	17
60.	107	111	2	12
61.	88	97	0	28
62.	97	103	0	21
63.	86	36	0	29
64.	88	96	6	23
65.	72	85	0	40
66.	92	100	0	25
67.	101	107	9	18
68.	88	97	0	28
69.	97	104	9	21
70.	94	101	2	22
71.	110	114	0	11
72.	100	106	1	18
73.	87	96	0	27
74.	97	103	0	22
75.	103	108	2	15
76.	100	106	0	19
77.	94	100	6	19
78.	102	108	0	17
79.	68	81	6	38
80.	115	117	1	7
81.	98	105	0	20
82.	65	79	0	41
83.	86	96	0	29
84.	89	98	2	26
85.	88	97	8	28
86.	84	04	0	31
87.	87	96	3	26
88.	91	97	11	17
89.	87	96	2	27
90.	92	100	0	26
91.	98	105	0	22
92.	98	104	3	18
93.	102	108	0	17
94.	95	101	6	18
95.	74	86	3	36

96.	112	115	0	10
97.	109	112	3	12
98.	109	113	1	11
99.	100	106	0	19
100.	99	105	2	18
101.	99	105	3	17
102.	98	105	0	20
103.	80	89	10	26
104.	72	77	33	15
105.	110	4	10	11
106.	67	73	35	12
107.	90	99	0	26
108.	69	83	1	41
109.	81	92	0	33
110.	80	91	1	33
111.	89	96	7	22
112.	84	94	1	50
113.	70	84	0	41
114.	95	102	1	22
115.	100	106	1	18
116.	81	87	21	17
117.	98	105	0	20
118.	112	115	0	10
119.	98	105	0	20
120.	76	88	0	37
121.	94	102	0	23
122.	91	99	2	24
123.	104	108	5	12
124.	93	101	0	24
125.	81	92	-1	22
126.	100	106	0	19
127.	78	90	0	35
128.	92	100	1	24
129.	93	100	4	21
130.	78	90	0	35
131.	79	87	14	24
132.	93	99	7	19
133.	92	100	0	25
134.	67	81	3	41
135.	75	86	7	29
136.	70	84	0	41
137.	95	101	5	19
138.	89	96	7	22
139.	104	109	0	16
140.	82	92	2	31
141.	84	94	0	31
142.	80	89	8	28
143.	63	78	2	45
144.	85	93	8	24
145.	82	90	11	24
146.	75	87	3	25

147.	82	93	0	32
148.	89	98	0	27
149.	88	97	0	28
150.	85	94	5	26
151.	96	103	1	21
152.	102	108	0	17
163.	92	100	0	25
154.	94	102	0	23
155.	106	111	0	14
156.	94	102	0	23
157.	93	101	0	24
158.	102	107	3	15
159.	109	113	1	11
160.	98	105	0	20
161.	80	91	0	34
162.	85	95	1	29
163.	89	97	0	28
164.	95	101	5	19
165.	89	98	1	26
166.	80	83	32	10
167.	90	97	7	21
168.	79	89	7	29
169.	95	102	1	22
170.	102	106	6	13
171.	97	104	1	20
172.	83	84	38	3
173.	92	100	0	25
174.	85	95	0	30
175.	81	89	13	23
176.	89	92	21	12
177.	75	86	5	34
178.	82	91	8	26
179.	69	83	0	42
180.	82	93	0	22
181.	92	100	0	25
182.	84	93	4	28
183.	92	100	1	24
184.	84	90	16	19
185.	89	98	1	36
186.	76	88	0	37
187.	93	101	0	24
188.	76	85	12	28
189.	83	93	3	29
190.	98	93	18	14
191.	100	104	9	12
192.	102	108	0	15
193.	81	92	0	53
194.	83	93	1	31
195.	65	80	0	45
196.	72	85	2	38
197.	78	85	18	22

198.	79	90	1	34
199.	81	92	0	33
200.	83	88	21	16
201.	85	95	0	30
202.	88	97	1	27
203.	64	79	0	46
204.	74	86	3	34
205.	83	93	3	29
206.	84	94	1	30
207.	100	100	5	14
208.	86	96	14	19
209.	80	91	0	34
210.	72	83	8	34
211.	92	96	17	12
212.	101	106	5	14
213.	97	103	3	19
214.	87	96	3	26
215.	90	99	0	26
216.	88	97	2	26
217.	89	98	0	27
218.	86	94	7	24
219.	80	91	0	24
220.	92	100	0	25
221.	82	93	0	32
222.	79	90	2	33
223.	89	96	8	21
224.	87	95	6	24
225.	86	96	0	29
226.	84	94	1	30
227.	74	86	4	25
228.	105	110	0	15
229.	110	114	0	11
230.	103	112	0	13
231.	98	105	0	20
232.	84	94	2	29
233.	97	104	0	21
234.	98	105	0	20
235.	93	100	5	20
236.	85	95	0	30
237.	101	107	0	18
238.	92	100	0	25
239.	93	99	8	18
240.	72	84	6	35
241.	80	86	21	18
242.	94	101	2	22
243.	76	88	2	35
244.	99	105	1	19
245.	109	113	1	11
246.	92	100	0	25
247.	92	93	0	32
248.	82	92	0	32

147.	82	93	0	32
148.	89	98	0	27
149.	88	97	0	28
150.	85	94	5	26
151.	96	103	1	21
152.	102	108	0	17
163.	92	100	0	25
154.	94	102	0	23
155.	106	111	0	14
156.	94	102	0	23
157.	93	101	0	24
158.	102	107	3	15
159.	109	113	1	11
160.	98	105	0	20
161.	80	91	0	34
162.	85	95	1	29
163.	89	97	0	28
164.	95	101	5	19
165.	89	98	1	26
166.	80	83	32	10
167.	90	97	7	21
168.	79	89	7	29
169.	95	102	1	22
170.	102	106	6	13
171.	97	104	1	20
172.	83	84	38	3
173.	92	100	0	25
174.	85	95	0	30
175.	81	89	13	23
176.	89	92	21	12
177.	75	86	5	34
178.	82	91	8	26
179.	69	83	0	42
180.	82	93	0	22
181.	92	100	0	25
182.	84	93	4	28
183.	92	100	1	24
184.	84	90	16	19
185.	89	98	1	36
186.	76	88	0	37
187.	93	101	0	24
188.	76	85	12	28
189.	83	93	3	29
190.	98	93	18	14
191.	100	104	9	12
192.	102	108	0	15
193.	81	92	0	53
194.	83	93	1	31
195.	65	80	0	45
196.	72	85	2	38
197.	78	85	18	22

198.	79	90	1	34
199.	81	92	0	33
200.	83	88	21	16
201.	85	95	0	30
202.	88	97	1	27
203.	64	79	0	46
204.	74	86	3	34
205.	83	93	3	29
206.	84	94	1	30
207.	100	100	5	14
208.	86	96	14	19
209.	80	91	0	34
210.	72	83	8	34
211.	92	96	17	12
212.	101	106	5	14
213.	97	103	3	19
214.	87	96	3	26
215.	90	99	0	26
216.	88	97	2	26
217.	89	98	0	27
218.	86	94	7	24
219.	80	91	0	24
220.	92	100	0	25
221.	82	93	0	32
222.	79	90	2	33
223.	89	96	8	21
224.	87	95	6	24
225.	86	96	0	29
226.	84	94	1	30
227.	74	86	4	25
228.	105	110	0	15
229.	110	114	0	11
230.	103	112	0	13
231.	98	105	0	20
232.	84	94	2	29
233.	97	104	0	21
234.	98	105	0	20
235.	93	100	5	20
236.	85	95	0	30
237.	101	107	0	18
238.	92	100	0	25
239.	93	99	8	18
240.	72	84	6	35
241.	80	86	21	18
242.	94	101	2	22
243.	76	88	2	35
244.	99	105	1	19
245.	109	113	1	11
246.	92	100	0	25
247.	92	93	0	32
248.	82	92	0	32

249.	82	90	12	23
250.	78	84	23	18
251.	76	80	8	31
252.	86	96	10	29
253.	88	97	0	28
254.	92	100	0	25
255.	92	100	1	24
250.	104	109	1	15
257.	94	102	0	23
258.	76	88	0	37
259.	75	86	5	34
260.	78	90	0	35
261.	72	85	1	39
262.	95	102	1	22
263.	90	98	2	25
264.	73	86	0	39
265.	66	80	2	43
266.	98	105	0	20
267.	81	90	9	26
268.	60	76	0	49
269.	103	108	3	14
270.	72	85	0	40
271.	101	107	1	17
272.	101	107	0	18
273.	111	114	1	10
274.	112	115	0	10
275.	109	112	0	13
276.	110	114	0	11
277.	108	112	1	12
278.	105	110	1	14
279.	103	108	2	15
280.	101	107	0	18
281.	106	110	4	11
282.	100	104	9	12
283.	62	67	44	14
284.	101	107	0	18
285.	101	107	1	17
286.	104	107	8	10
287.	92	100	1	24
288.	92	100	0	25
289.	81	88	16	21
290.	84	94	0	31
291.	92	100	0	25
292.	77	89	0	36
293.	92	100	2	23
294.	82	93	0	32
295-	96	103	0	22
296.	82	91	6	28
297.	99	104	7	14
298.	68	82	0	43

299.	82	91	6	28
300.	98	105	0	20
301.	92	100	0	25
302.	98	105	0	20
303.	79	90	2	33
304.	89	94	16	15
305.	86	93	10	52
306.	92	99	5	21
307.	82	93	0	32
308.	105	110	0	15
309.	78	90	0	35
310.	73	93	13	29
311.	78	88	6	31
312.	92	90	10	25
313.	86	82	14	19
314.	89	99	1	26
315.	84	94	1	30
316.	70	78	22	25
317.	68	82	0	43
318.	80	21	1	33
319.	58	68	26	31
320,	101	107	0	18
321.	97	104	1	20
322.	103	108	2	15
323.	89	98	0	27
324.	90	103	0	22
325.	76	88	0	37
326.	22	99	5	21
327.	102	106	6	12
328.	85	95	1	29
329.	109	113	0	12
330.	104	109	0	16
331.	87	96	2	27
332.	62	67	43	15
333.	91	95	19	11
334.	100	106	0	19
335.	77	86	11	28
336.	89	97	4	24
337.	93	101	0	24
338.	92	95	21	9
339.	69	82	3	40

The coefficient of correlation

r=0.97

249.	82	90	12	23
250.	78	84	23	18
251.	76	80	8	31
252.	86	96	10	29
253.	88	97	0	28
254.	92	100	0	25
255.	92	100	1	24
250.	104	109	1	15
257.	94	102	0	23
258.	76	88	0	37
259.	75	86	5	34
260.	78	90	0	35
261.	72	85	1	39
262.	95	102	1	22
263.	90	98	2	25
264.	73	86	0	39
265.	66	80	2	43
266.	98	105	0	20
267.	81	90	9	26
268.	60	76	0	49
269.	103	108	3	14
270.	72	85	0	40
271.	101	107	1	17
272.	101	107	0	18
273.	111	114	1	10
274.	112	115	0	10
275.	109	112	0	13
276.	110	114	0	11
277.	108	112	1	12
278.	105	110	1	14
279.	103	108	2	15
280.	101	107	0	18
281.	106	110	4	11
282.	100	104	9	12
283.	62	67	44	14
284.	101	107	0	18
285.	101	107	1	17
286.	104	107	8	10
287.	92	100	1	24
288.	92	100	0	25
289.	81	88	16	21
290.	84	94	0	31
291.	92	100	0	25
292.	77	89	0	36
293.	92	100	2.	23
294.	82	93	0	32
295-	96	103	0	22
296.	82	91	6	28
297.	99	104	7	14
298.	68	82	0	43

299.	82	91	6	28
300.	98	105	0	20
301.	92	100	0	25
302.	98	105	0	20
303.	79	90	2	33
304.	89	94	16	15
305.	86	93	10	52
306.	92	99	5	21
307.	82	93	0	32
308.	105	110	0	15
309.	78	90	0	35
310.	73	93	13	29
311.	78	88	6	31
312.	92	90	10	25
313.	86	82	14	19
314.	89	99	1	26
315.	84	94	1	30
316.	70	78	22	25
317.	68	82	0	43
318.	80	21	1	33
319.	58	68	26	31
320.	101	107	0	18
321.	97	104	1	20
322.	103	108	2	15
323.	89	98	0	27
324.	90	103	0	22
325.	76	88	0	37
326.	22	99	5	21
327.	102	106	6	12
328.	85	95	1	29
329.	109	113	0	12
330.	104	109	0	16
331.	87	96	2	27
332.	62	67	43	15
333.	91	95	19	11
334.	100	106	0	19
335.	77	86	11	28
336.	89	97	4	24
337.	93	101	0	24
338.	92	95	21	9
339.	69	82	3	40

The coefficient of correlation

$r=0.97$

CORRELATIONAL TABLE

Uncorrected Scores / Corrected Scores	70-75	75-80	80-85	85-90	90-95	95-100	100-105	105-110	110-115	115-120	Total
60-65	3	4									7
65-70	3	1	10								14
70-75		2	6	9							17
75-80			2	23	8						33
80-85			2	7	44						53
85-90					9	44					53
90-95						13	41				54
95-100							23	16			39
100-105							2	37			39
105-110									16	1	17
110-115									5	8	13
Total	6	7	20	39	61	57	66	53	21	9	339=N

$r=0.97$

Significant at 0.01 level.

PROJECT—7

A RESEARCH STUDY BASED ON DISTRACTOR ANALYSIS OF THE S.A.T. ITEMS

Dr. K. N. Saxena
S. K. Batra

Problem :

Is it justifiable to apply the guessing factor formula $S=R-\frac{KW}{n-k}$ to correct for guessing and chance factor in scoring of objective type test (i.e. S.A.T.), consisting of multiple choice questions where :—

S = Corrected Score
R = the number of right responses
W = the number of wrong responses
n = the number of suggested responses for a single item
k = the number of responses to be selected or marked for each item.

The basic assumption involved in the application of the aforesaid formula for scoring is that all the wrong responses are equally attractive or equally likely to be selected. In order to observe the attractiveness of various distractors and the difficulty level of each item (set in the compulsory as well as in the optional parts of the test, except mathematics) for low achievers, for mediocres and for high achievers, a detailed study has been reported in Appendix XX. Due to lackness of sufficient data, the aforesaid study has not been carried out in case of mathematics, the optional part of the test.

The students were classified into groups of interval 20 marks each with respect to their scores obtained in the S.A.T. The groups have been formed on a six point scale ranging from 0—120. The middle class comprises the marks range 41 to 80. It is suggested to find the expected score of the student attempting the Science Aptitude Test purely on random basis at 99% level of confidence.

Let X be a variable representing score on one item of the test. Therefore X takes the values 1 and $-\frac{1}{3}$ with probabilities $\frac{1}{4}$ and $\frac{3}{4}$. Since the student gets 1 mark if he succeeds at the item and gets $-\frac{1}{3}$ if he fails in an attempted item.

Therefore, the expected score at one item is zero. Since the test is composed of 275 homogeneous questions and a students who has attempted 125 questions, his expected score is $E(S) = E(X_1 + \ldots\ldots \ldots \ldots + X_{125})$ where

$X_1 \ldots\ldots\ldots X_{125}$ represent the scores on 1st, 2nd...............and 125th item of the test.

$$E(X_1X_2)=0$$

$$V(X_1)=\frac{1}{3}$$

$$\therefore \quad V(S)=\frac{125}{3}=42 \text{ (approximately)}$$

Since 125 is a large number of items, by Central Limit Theorem.

$$\frac{\frac{S}{125}-0}{\frac{\sqrt{42}}{125}} \text{ (is a normalvariate with mean zero and S.D.}=1)$$

Therefore S = 6.5X2.58=17

But in our present study we have taken the first group of those students who are scoring less than 20 marks.

For the compulsory part of the test, it has been observed that in most of the questions the distractors are not equally attractive for the lowest group. In case of the next lowest group (i.e. the 2nd group), the position is slightly better. But for the highest and next highest groups the tendency of the students is not to go in for guessing but omission. In most of the items of the compulsory part of the test e.g. item No. 3, 5, 56, 58, 59, 60, 61, 64, 65, 67, 68, 69, 70, 71, 73, 74, and 75, the distractors are not equally attractive for the highest and next highest groups. The aforesaid set of items consists of all the rejected items based on the discriminative and difficulty levels. In some of the items only three out of the four choices are equally attractive, meaning thereby that one distractor is not functioning properly. It seems reasonable to expect that students possessing high calibre can easily spot out the correct response, while less able students mark the wrong answer, thinking it to be predominently attractive.

There is a marked variation in the % age of students choosing the right responses and the omissions committed for an item in the lowest, next lowest and the middle groups in both parts of the test. In the next highest and highest groups there is no marked variation in the % age of choosing right response and omissions committed except in very few items.

From the present study, it appears that an effort should be made to make the test more homogenous from the point of view of difficulty level of each item and by bringing up the gulf between the various distractors within an item.

A STUDY TO OBSERVE THE ATTRACTIVENESS OF VARIOUS DISTRACTORS OF THE MULTIPLE CHOICE ITEMS OF THE COMPULSORY PART OF THE SCIENCE APTITUDE TEST, YEAR 1967 STUDENTS CLASSIFIED BY THE TOTAL TEST SCORE

Item	Responses	Lowest 0-20	Next lowest 21-40	Middle 41-60	Middle 61-80	Next highest 81-100	Highest 101-120	Total
No. 1	Omit	4	4	2	0	0	0	10
	*A	9	17	30	48	49	49	202
	B	18	15	13	1	1	5	48
	C	11	4	1	1	0	1	18
	D	8	10	4	0	0	0	22
	Total	50	50	50	50	50	50	
Percent of total group of 300 students answering correctly...........................								68%
Item No.2	Omit	5	5	2	0	3	0	15
	*A	5	4	16	39	44	50	158
	B	21	20	19	7	•1	0	68
	C	7	3	2	0	0	0	12
	D	12	18	11	4	2	0	47
	Total	50	50	50	50	50	50	
Percent of total group of 300 students answering correctly...........................								53%
Item No.3	Omit	6	6	2	2	3	0	19
	A	14	11	12	7	9	4	57
	B	7	4	2	0	0	0	13
	C	7	6	4	6	0	0	23
	*D	16	23	30	35	38	46	188
	Total	50	50	50	50	50	50	
Percent of Total group of 300 students answering correctly...........................								63%
Item No.4	Omit	5	6	3	2	1	0	17
	A	6	6	3	2	0	0	17
	*B	21	30	27	42	46	50	216
	C	16	8	13	4	2	0	43
	D	2	0	4	0	1	0	7
	Total	50	50	50	50	50	50	
Percent of Total group of 300 students answering correctly...........................								27%

Item No.5 Omit	3	3	1	1	2	0	10
A	12	21	20	22	25	15	115
*B	5	14	10	18	21	34	102
C	13	8	12	3	1	1	33
D	17	4	7	6	1	0	35
Total	50	50	50	50	50	50	

Percent of Total group of 300 students answering correctly........................... 34%

Item No.6 Omit	3	5	0	0	0	0	8
A	11	9	11	7	2	2	42
B	10	5	1	0	0	0	16
*C	21	29	34	43	47	48	222
D	5	2	4	0	1	0	12
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly........................... 74%

Item No.7 Omit	3	2	0	2	0	0	7
A	10	7	6	1	0	0	24
*B	11	23	34	45	50	50	213
C	13	11	6	2	0	0	32
D	13	7	4	0	0	0	24
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly........................... 71%

Item No.8 Omit	3	4	0	1	0	0	8
A	5	4	3	7	2	0	21
B	4	1	3	0	0	0	8
*C	27	40	44	42	48	50	251
D	11	1	0	0	0	0	12
Total	50	50	50	50	50	50	

Percent of total group of 300 students scoring correctly............................. 84%

Item No.9 Omit	0	1	0	0	0	0	1
A	4	4	5	3	2	0	18
*B	24	25	34	41	47	49	220
C	17	13	8	4	0	1	43
D	5	7	3	2	1	0	18
Total	50	50	50	50	50	50	

Percent of total group of 300 students scoring correctly............................. 73 %

Item No,10 Omit	3	2	1	0	0	0	6
A	2	5	4	5	6	3	25
B	10	8	7	5	2	0	32
*C	21	23	34	37	42	47	203
D	14	12	4	3	1	0	34
Total	50	50	50	50	50	50	

Percent of total group of 300 students scoring correctly.................................. 68%

Item No.11 Omit	3	2	1	1	0	0	7
A	1	5	9	1	2	0	18
B	15	11	5	7	7	0	45
C	10	14	8	5	1	0	38
*D	21	18	27	36	40	50	192
Total	50	50	50	50	50	50	

Percent of total group of 300 students scoring correctly.................................. 64%

tem No.12 Omit	3	3	0	0	0	0	6
*A	21	32	34	48	50	49	224
B	6	4	12	2	0	0	24
C	8	3	0	0	0	0	10
D	12	9	0	0	0	1	26
Total	50	50	50	50	50	50	

Percent of total group of 300 students scoring correctly.................................. 78%

Item No.13 Omit	1	4	0	2	1	0	8
*A	15	7	10	8	9	24	73
B	17	13	17	16	30	22	115
C	8	16	12	12	6	3	57
D	9	10	11	12	4	1	47
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly.................................. 24%

Item No.14 Omit	5	7	2	2	0	0	15
A	8	13	12	11	3	1	48
B	8	5	5	4	2	1	25
C	6	1	2	0	1	0	10
*D	22	35	29	35	44	48	202
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly.................................. 67%

Item No. 15 Omit	5	6	0	0	9	0	11
A	16	11	8	8	3	2	48
B	2	1	1	0	0	4	4
*C	11	23	41	38	56	48	207
D	16	9	0	4	1	0	30
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly...... .... 69%

Item No. 16 Omit	5	5	0	0	1	0	11
*A	13	34	37	47	48	50	229
B	9	4	7	2	1	0	23
C	9	5	6	1	0	0	21
D	14	2	0	0	0	0	16
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly.................. .... 76%

Item No. 17 Omit	9	6	1	0	0	0	16
A	8	16	7	2	1	0	34
B	14	8	4	6	4	0	36
*C	15	17	35	42	45	50	204
D	4	3	3	0	0	0	10
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly............................ 68%

Item No. 18 Omit	6	5	5	0	0	0	11
A	3	4	3	0	0	0	10
B	7	0	7	0	0	1	15
C	7	4	0	1	0	0	12
*D	27	37	40	49	50	49	252
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly............................ 84%

Item No. 19 Omit	6	5	0	0	1	0	12
*A	20	23	21	37	44	49	194
B	4	3	0	0	1	1	9
C	15	17	27	13	4	0	76
D	5	2	2	0	0	0	9
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly............................ 65%

Item No.20 Omit	6	5	0	0	0	0	11
A	6	6	7	5	5	1	30
B	23	11	10	5	0	0	49
C	8	0	3	P	0	0	12
*D	7	28	30	39	45	49	198
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly.....................—...... 60%

Item No.21 Omit	5	5	0	3	1	0	14
*A	0	7	8	11	18	33	77
B	4	2	8	3	3	3	23
C	37	33	32	32	28	14	176
D	4	3	2	1	0	0	10
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly............................ 26%

Item No.22 Omit	5	6	0	0	2	0	13
*A	12	22	23	25	21	31	134
B	17	15	25	20	25	19	191
C	8	5	2	5	2	0	22
D	8	2	0	0	0	0	10
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly.......................... ...45%

Item No.23 Omit	5	7	4	2	6	0	24
A	13	5	5	7	4	3	37
B	6	7	2	4	1	4	24
*C	15	18	31	24	34	37	159
D	11	13	8	13	5	6	56
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly............................ 53%

Item No.24 Omit	1	6	0	0	0	0	7
*A	23	32	43	44	42	47	231
B	11	7	4	4	5	2	33
C	5	2	1	1	3	1	13
D	10	3	2	2	0	0	16
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly............................ 77%

Item No.25 Omit	3	4	4	4	3	0	18
A	9	9	17	16	16	4	71
*B	19	23	17	21	19	29	128
C	9	4	5	2	5	4	29
D	10	10	7	7	7	13	54
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly........................ 43%

Item No.26 Omit	0	2	2	1	0	0	5
A	31	16	18	13	14	2	101
B	7	7	8	2	3	4	31
C	5	5	4	0	1	0	15
*D	7	20	18	34	32	37	148
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly... .... 49%

Item No.27 Omit	3	6	4	3	2	0	18
A	8	13	9	4	4	2	40
B	22	14	20	26	18	17	117
*C	7	8	5	6	11	21	58
D	10	9	12	11	15	10	67
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly...... .... 19%

Item No.28 Omit	0	2	0	4	1	0	7
A	4	1	2	7	7	3	24
*B	18	16	11	9	20	29	103
C	5	3	1	5	1	1	16
D	23	28	36	25	21	17	150
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly........................ 34%

Item No. 29 Omit	1	4	1	1	4	0	11
*A	20	30	38	44	45	49	226
B	2	3	3	1	1	0	10
C	22	12	8	3	0	1	46
D	5	1	0	1	0	0	7
Total	50	50	50	50	50	50	50

Percent of total group of 300 students answering correctly.....................75%

Item No. 30 Omit	4	5	3	3	3	0	18
A	31	26	16	8	4	2	87
*B	13	14	24	32	41	46	170
C	2	2	3	3	1	1	12
D	0	3	4	4	1	1	13
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly......................57%

Item No. 31 Omit	1	2	1	0	0	0	4
A	13	16	11	7	6	0	53
*B	14	21	27	30	39	48	185
C	12	5	7	4	4	2	34
D	10	6	4	3	1	0	24
Total	50	50	40	50	50	50	

Percent of total group of 300 students answering correctly................. 52%

Item No. 32 Omit	1	1	0	0	0	0	2
A	8	0	1	3	0	2	14
B	10	5	0	0	2	0	17
C	5	1	0	0	0	0	6
*D	26	43	42	47	48	48	261
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly...................... 97%

Item No. 33 Omit	4	3	1	0	2	0	10
*A	10	19	23	31	36	35	154
B	15	10	8	10	1	1	45
C	13	15	15	9	6	4	62
D	9	3	3	0	5	10	29
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly.. ....51%

Item No. 34 Omit	3	4	0	2	0	0	9
A	6	2	2	2	2	2	16
B	15	6	8	5	1	0	35
C	17	19	25	9	9	1	80
*D	9	89	15	32	38	47	160
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly.. ....53%

Item No. 35 Omit	5	3	1	0	0	0	9
A	8	5	3	0	2	0	18
*B	14	18	29	36	38	49	184
C	12	20	13	10	13	1	69
D	11	4	4	1	0	0	20
Total	50	50	50	50	50	50	

Percent of total group of 300 students answering correctly....................61%

Item No. 36 Omit	4	4	0	0	0	0	8
*A	13	29	40	46	47	50	225
B	4	6	2	0	0	0	12
C	19	9	5	4	2	0	39
D	10	2	3	0	1	0	16
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly...............75%

Item No. 37 Omit	5	4	1	0	0	0	10
A	14	3	4	0	2	0	23
*B	13	31	37	47	47	49	224
C	10	3	5	0	0	0	18
D	8	9	3	3	1	1	25
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly........ ....75%

Item No. 38 Omit	7	9	3	1	0	0	20
A	11	5	5	2	0	0	23
*B	8	19	32	42	49	50	200
C	18	13	5	5	1	0	42
D	6	4	5	0	0	0	15
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.. ....67%

Item No. 39 Omit	6	5	1	2	0	0	14
A	8	2	1	0	0	2	13
*B	20	38	42	47	46	48	241
C	10	3	3	0	4	0	20
D	6	2	3	1	0	0	12
Total	50	50	50	40	50	50	

Percent of the total group of 300 students answering correctly..... ....80%

Item No. 40 Omit	8	7	1	2	0	0	18
A	4	2	1	2	0	0	19
B	9	2	2	1	2	0	16
C	14	4	4	1	0	1	24
*D	15	35	42	44	48	49	233
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly...............79%

Item No. 41 Omit	3	3	0	0	0	0	6
A	11	5	3	0	1	1	21
*B	19	33	41	50	49	49	240
C	7	4	2	0	1	0	14
D	10	5	4	0	0	0	19
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.............. 80%

Item No. 42 Omit	3	4	1	0	0	1	11
A	9	2	0	0	0	0	11
*B	15	33	42	48	49	49	236
C	10	3	5	2	0	0	20
D	13	8	2	0	1	0	24
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................79%

Item No. 43 Omit	5	7	0	0	1	0	13
A	7	9	14	6	1	1	38
B	20	23	17	12	5	1	78
*C	10	7	11	32	43	48	151
D	8	4	8	0	0	0	20
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................50%

Item No. 44 Omit	7	8	2	0	0	0	17
A	6	5	9	5	4	2	31
B	21	19	17	6	2	5	70
C	12	7	2	5	0	0	26
*D	4	11	20	34	44	43	156
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................52%

Item No. 45 Omit	9	7	2	0	0	1	19
A	7	3	4	1	0	0	15
B	15	7	4	1	0	0	27
*C	12	15	27	40	48	47	189
D	7	18	13	8	2	2	50
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.....................63%

Item No. 46 Omit	6	5	0	0	0	0	11
A	11	5	3	0	2	0	21
*B	5	16	23	40	48	50	182
C	5	8	7	3	0	0	23
D	23	16	17	7	0	0	63
Total	50	50	50	50	50.	50	50

Percent of the total group of 300 students answering correctly.................... 61%

Item No. 47 Omit	7	5	0	1	0	0	13
A	18	17	11	4	0	0	50
*B	12	13	29	44	50	50	198
C	6	6	5	1	0	0	18
D	7	9	5	0	0	0	21
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly...................66%

Item No. 48 Omit	5	5	0	0	2	0	12
A	6	4	4	3	0	0	17
B	14	6	4	4	1	0	29
*C	11	20	28	34	38	49	180
D	14	15	14	9	9	1	62
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................60%

Item No. 49 Omit	9	6	1	0	0	0	16
A	6	22	21	10	3	0	62
*B	8	11	17	38	47	49	170
C	18	5	10	2	0	0	35
D	9	6	1	0	0	1	17
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 57%

Item No. 50	Omit	8	6	1	0	0	0	15
	A	8	9	5	1	0	0	23
	B	10	10	5	6	0	0	23
	*C	14	15	25	34	50	48	186
	D	10	10	14	9	0	2	45
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................... 62%

Item No. 51	Omit	7	4	1	3	3	0	18
	A	13	14	23	24	10	1	85
	*B	12	16	15	19	27	42	131
	C	10	12	7	0	6	2	37
	D	8	4	4	4	4	5	29
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................44%

Item No. 52	Omit	6	6	2	1	2	0	17
	*A	4	16	24	44	45	48	181
	B	6	2	4	2	0	2	16
	C	28	15	9	1	2	0	55
	D	6	11	11	2	1	0	31
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................60%

Item No. 53	Omit	10	11	4	2	3	0	30
	A	10	0	4	0	1	0	15
	B	11	15	20	14	3	1	64
	*C	10	20	17	32	43	49	171
	D	9	4	5	2	0	0	20
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................57%

Item No. 54	Omit	9	7	2	2	0	0	20
	A	15	17	18	3	0	2	55
	*B	12	10	16	40	49	46	173
	C	10	13	9	5	1	2	40
	D	4	3	5	0	0	0	12
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly......................58%

Item No. 55 Omit	10	7	1	2	0	0	20
A	6	4	2	0	1	0	13
B	10	14	10	8	1	1	44
C	7	3	3	9	2	0	17
*D	17	22	34	38	46	49	206
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.....................69%

Item No. 56 Omit	10	7	1	0	0	0	18
A	16	7	3	5	1	0	29
B	12	17	23	9	9	5	75
C	9	5	4	7	3	2	30
*D	3	41	19	32	37	43	148
Total	50	50	59	50	50	50	

Percent of the total group of 300 students answering correctly..................... 49%

Item No.57 Omit	8	4	2	0	0	0	14
A	9	7	3	1	0	0	20
*B	9	23	35	48	50	50	215
C	12	11	5	1	0	0	29
D	12	5	5	0	0	0	22
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 72%

Item No.58 Omit	11	10	1	0	2	0	24
A	10	16	12	6	4	3	51
B	4	6	5	0	0	0	15
*C	21	16	31	43	44	47	202
D	4	2	1	1	0	0	8
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 67%

Item No.59 Omit	8	3	0	0	0	0	11
A	8	9	6	7	6	1	37
B	12	6	3	1	1	0	23
*C	20	30	41	42	43	49	225
D	2	2	0	0	0	0	4
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 75%

Item No.60	Omit	11	5	2	0	2	0	20
	A	4	7	5	12	2	2	32
	*B	13	16	12	14	10	22	87
	C	14	11	17	6	1	0	49
	D	8	11	14	18	35	26	112
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 29%

Item No.61	Omit	9	6	0	0	1	0	16
	A	10	4	1	2	0	0	17
	B	3	0	0	1	0	0	4
	*C	17	28	29	30	40	49	193
	D	11	12	20	17	9	1	70
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 64%

Item No.62	Omit	11	8	0	0	0	0	19
	*A	19	32	47	48	50	50	246
	B	8	4	2	1	0	0	15
	C	3	5	1	1	0	0	10
	D	9	1	0	0	0	0	10
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 82%

Item No.63	Omit	10	9	0	0	0	0	19
	A	9	1	1	0	0	0	11
	B	7	0	0	0	0	0	7
	C	4	0	5	3	2	1	21
	*D	20	34	44	47	48	49	242
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 81%

Item No.64	Omit	13	9	0	0	2	1	25
	A	9	5	5	0	4	11	24
	B	10	7	11	1	0	0	29
	*C	11	21	32	49	44	48	205
	D	7	8	2	0	0	0	17
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 63%

Item No.65	Omit	13	10	0	0	0	0	23
	A	3	1	0	0	0	0	4
	B	15	3	2	0	0	0	20
	C	9	7	15	5	3	4	43
	*D	10	29	33	45	47	46	210
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 70%

Item No.66	Omit	12	8	0	1	0	0	21
	*A	2	17	25	42	49	46	181
	B	18	16	16	5	0	3	58
	C	7	2	2	0	1	0	12
	D	11	7	7	2	0	1	28
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 60%

Item No.67	Omit	11	8	0	1	0	0	20
	A	10	19	21	5	1	0	56
	B	17	5	3	3	0	0	28
	*C	7	14	26	41	49	50	187
	D	5	4	0	0	0	0	9
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 62%

Item No.68	Omit	13	11	1	2	1	0	28
	A	4	6	6	3	7	1	27
	*B	23	24	35	44	42	49	217
	C	10	7	5	0	0	0	22
	D	0	2	3	1	0	0	6
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. .72%

Item No.69	Omit	11	11	1	4	3	0	30
	A	6	6	3	5	5	3	28
	B	7	14	16	25	29	21	212
	C	20	16	22	13	4	4	79
	*D	6	3	8	3	9	22	51
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly..................17%

Item No.70 Omit	10	12	0	3	3	0	28
A	13	16	17	6	3	1	56
B	6	3	4	1	0	1	15
*C	7	7	9	13	21	29	86
D	14	12	20	27	23	19	115
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.............. 29%

Item No.71 Omit	7	13	6	3	2	1	32
A	6	5	11	9	3	4	38
B	19	8	10	11	7	2	57
*C	6	18	18	23	36	43	144
D	12	6	5	4	2	0	29
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 48%

Item No.72 Omit	7	12	3	2	2	0	26
A	14	5	18	7	2	0	46
*B	5	10	9	29	43	48	144
C	14	16	13	6	1	2	52
D	10	7	7	6	2	0	32
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 48%

Item No.73 Omit	10	12	5	5	5	0	37
A	8	11	6	4	3	1	33
B	13	4	7	4	6	4	48
*C	10	12	19	33	35	44	154
D	9	11	13	3	1	1	38
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.............. 51%

Item No.74 Omit	9	13	4	11	5	0	42
A	6	6	10	8	3	0	33
B	8	5	13	6	10	0	42
C	20	17	14	5	2	0	58
*D	7	9	9	20	30	50	125
Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 42%

Item No.75	Omit	11	13	5	8	7	0	44
	*A	5	7	5	24	35	44	120
	B	3	5	7	5	1	0	21
	C	9	7	11	6	5	4	42
	D	22	18	22	7	2	2	73
	Total	50	50	50	50	50	50	

Percent of the total group of 300 students answering correctly.................. 40%

A STUDY TO CHECK THE ATTRACTIVENESS OF THE VARIOUS DISTRACTORS OF THE MULTIPLE-CHOICE QUESTIONS SET IN THE OPTIONAL PART (PHYSICS) OF THE SCIENCE APTITUDE TEST YEAR 1967.

STUDENTS CLASSIFIED BY TOTAL TEST SCORE

Responses		Lowest	Next lowest	Middle		Next highest	Highest	Total
		0-20	21-40	41-60	61-80	81-100	101—120	
Item No. 1	Omit	0	0	0	0	0	0	0
	A	3	1	0	0	0	0	4
	B	2	2	0	0	0	0	4
	*C	20	22	25	25	25	20	137
	D	0	0	0	0	0	0	0
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 96%

Responses		Lowest	Next lowest	Middle		Next highest	Highest	Total
Item No. 2	Omit	0	0	1	0	0	0	1
	*A	16	21	23	25	25	20	130
	B	2	0	0	0	0	0	2
	C	6	3	1	0	0	0	10
	D	1	1	0	0	0	0	2
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 91%

Responses		Lowest	Next lowest	Middle		Next highest	Highest	Total
Item No. 3	Omit	0	0	1	0	0	0	1
	A	4	2	1	0	0	0	7
	*B	16	22	23	25	25	20	131
	C	4	1	0	0	0	0	5
	D	1	0	0	0	0	0	1
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly................ 91%

Item No.4 Omit	1	1	1	0	0	0	3
*A	13	16	18	25	23	18	113
B	5	0	0	0	2	0	7
C	2	0	2	0	0	0	4
D	4	8	4	0	0	2	18
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 79%

Item No.5 Omit	0	0	0	1	0	0	1
A	4	2	2	0	0	0	8
*B	17	18	22	22	25	20	124
C	3	4	1	2	0	0	10
D	1	1	0	0	0	0	2
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 86%

Item No.6 Omit	1	0	0	0	0	0	1
A	5	3	1	2	0	2	13
B	2	0	0	0	0	0	2
*C	8	15	21	21	20	18	103
D	9	7	3	2	5	0	26
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 72%

Item No.7 Omit	0	0	0	1	0	0	1
A	9	6	7	9	6	3	40
B	7	8	7	1	0	0	23
C	6	3	3	2	3	1	18
*D	3	8	8	12	16	16	63
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 44%

Item No.8 Omit	1	3	1	1	0	1	7
A	9	9	10	12	5	0	45
B	4	3	2	3	4	1	17
C	0	2	2	0	0	0	4
*D	11	8	10	9	16	18	72
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.....................50%

Item No. 9	Omit	2	1	1	1	0	0	4
	*A	17	21	20	22	21	19	120
	B	0	0	1	0	0	0	1
	C	3	3	2	2	1	0	11
	D	3	0	1	1	3	1	9
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 84%

Item No. 10	Omit	3	1	8	5	4	2	23
	*A	2	2	5	6	4	13	32
	B	5	12	2	8	9	0	36
	C	9	7	7	5	3	3	34
	D	6	3	3	1	5	2	20
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly............——— 22%

Item No. 11	Omit	2	1	1	2	0	0	6
	A	8	6	5	1	0	0	20
	B	4	5	2	2	0	0	13
	*C	9	12	16	18	25	20	100
	D	2	1	1	2	0	0	6
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly........................70%

Item No. 12	Omit	0	1	1	0	0	0	6
	A	9	16	15	18	21	13	92
	*B	4	4	4	1	4	4	21
	C	5	2	0	0	0	1	8
	D	7	2	5	6	0	2	22
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 14%

Item No. 13	Omit	0	1	0	0	0	0	1
	A	6	9	6	0	0	0	24
	B	3	0	0	1	4	2	10
	*C	8	9	12	19	21	18	87
	D	8	6	1	2	0	0	23
	Total	25	25	25	26	25	20	

Percent of the total group 145 students answering correctly..................... 60%

Item No. 14	Omit	0	1	2	0	0	0	3
	A	3	2	1	2	1	0	9
	*B	13	12	6	6	16	18	71
	C	7	2	10	13	4	0	36
	D	2	8	6	4	4	2	26
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 49%

Item No. 15	Omit	2	1	2	1	0	0	6
	*A	3	9	8	15	21	19	75
	B	6	1	7	6	3	1	24
	C	5	8	5	2	0	0	20
	D	9	6	3	1	1	0	20
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 32%

Item No. 16	Omit	0	2	2	2	0	0	6
	A	6	4	8	8	6	4	36
	B	3	2	5	2	2	0	14
	*C	6	8	3	10	10	10	47
	D	10	9	7	3	7	6	42
	Total	25	25	25	25	25	20	

Percent of tht total group of 145 students answering correctly.................. 32%

Item No. 17	Omit	0	0	1	1	0	0	2
	A	2	1	0	0	0	0	3
	*B	17	20	23	23	25	20	128
	C	6	4	0	1	0	0	11
	D	0	0	1	0	0	0	11
	Total	25	25	25	24	25	20	

Percent of the total group of 145 students answering correctly.................. 89%

Item No. 18	Omit	1	1	4	1	0	0	7
	A	13	5	2	2	1	0	23
	B	4	8	10	10	4	5	41
	C	3	6	4	2	3	0	18
	*D	4	5	5	10	17	15	65
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 39%

Item No. 19 Omit	1	1	2	2	0	0	6
A	7	6	3	2	0	0	18
B	8	2	0	0	1	0	11
*C	5	14	14	18	23	17	91
D	4	2	6	3	1	3	19
Total	25	25	25	25	25	20	

Percent of the total group of 145 Students answering correctly.................. 63%

Item No. 20 Omit	0	0	0	0	0	0	0
*A	19	22	24	25	25	20	135
B	0	0	0	0	0	0	0
C	3	3	1	0	0	0	7
D	3	0	0	0	0	0	3
Total	25	25	25	25	25	20	

Percent of the total group of 145 Students answering correctly............... 94%

Item No. 21 Omit	2	5	8	1	0	0	16
A	8	6	6	6	6	1	34
*B	4	8	4	14	16	19	65
C	7	4	6	3	3	0	33
D	4	1	1	1	0	0	7
Total	25	25	25	25	25	20	

Perecnt of the total group of 145 Students answering correctly............... 45%

Item No. 22 Omit	4	2	6	1	0	0	13
A	11	8	6	4	2	1	32
*B	0	4	4	7	17	18	50
C	8	8	9	12	6	1	44
D	2	3	9	1	0	0	6
Total	25	25	25	25	25	20	

Percent of the total group of 145 Students answering correctly............... 35%

Item No. 23 Omit	1	4	3	3	0	0	11
A	8	15	12	7	5	1	48
B	5	2	4	4	3	1	19
C	6	2	1	0	0	0	9
*D	5	2	5	11	17	18	58
Total	25	25	25	25	25	20	

Percent of the total group of 145 Students answering correctly 40%

Item No. 24	Omit	2	2	3	0	0	0
	A	5	5	5	3	1	0	1
	B	5	5	5	5	3	1	2
	*C	9	8	7	8	7	15	5
	D	4	5	5	9	14	4	4
	Total	25	26	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 37

Item No. 25	Omit	3	4	2	1	1	0	1
	A	5	10	12	6	8	0	4
	B	11	3	1	1	2	1	1
	*C	6	6	6	15	13	18	6
	D	0	2	4	2	1	1	1
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 4

Item No. 26	Omit	1	3	1	1	1	0	[illegible]
	A	10	14	13	8	5	3	5
	B	6	5	11	7	5	1	3
	C	2	0	0	3	1	1	7
	*D	6	3	0	6	13	15	43
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 30

Item No. 27	Omit	1	4	2	0	0	0	7
	A	5	7	9	1	1	1	24
	B	9	3	1	2	2	0	17
	*C	1	2	5	11	16	15	50
	D	9	9	8	11	6	4	47
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 35

Item No. 28	Omit	1	1	2	2	1	0	7
	A	1	2	1	4	0	2	10
	*B	1	4	4	6	14	18	46
	C	1	2	0	2	0	0	5
	D	21	16	18	11	10	0	76
	Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 32

Item No.29 Omit	1	4	3	0	2	0	10
A	6	4	7	5	2	0	24
B	12	4	6	3	0	0	25
C	6	5	8	8	2	0	29
*D	0	8	1	9	19	20	57
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 39%

Item No.30 Omit	1	1	2	0	0	0	4
A	7	6	0	2	0	0	15
*B	11	16	23	23	24	20	117
C	4	0	0	0	0	0	4
D	2	2	0	0	1	0	5
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 81%

Item No.31 Omit	1	2	2	0	0	0	5
A	9	5	3	3	0	0	20
B	4	7	2	1	0	1	15
*C	5	11	17	19	25	19	96
D	6	0	1	2	0	0	9
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.................. 67%

Item No.32 Omit	3	2	4	2	1	0	12
A	1	3	0	1	0	0	5
B	12	8	15	6	4	1	46
*C	2	10	5	16	19	18	70
D	7	2	1	0	1	1	12
Total	25	25	25	25	25	20	

Percent of the group of 145 students answering correctly........................ 49%

Item No.33 Omit	3	2	3	1	0	0	9
A	6	6	3	4	0	0	19
B	7	2	2	2	1	2	16
C	9	10	5	7	0	0	31
*D	0	5	12	11	24	18	70
Total	25	25	25	25	25	20	

Percent of the group of 145 students answering correctly........................ 49%

Item No.34	Omit	4	2	2	0	0	0	8
	*A	4	5	10	17	25	20	81
	B	9	9	6	5	0	0	29
	C	5	3	5	3	0	0	16
	D	3	6	2	0	0	0	11
	Total	25	25	25	25	25	20	
	Percent of the group of 145 students answering correctly..........................							56%
Item No.35	Omit	3	3	5	1	1	0	13
	A	2	8	4	2	0	3	23
	*B	4	6	11	16	19	19	75
	C	7	5	2	1	1	0	16
	D	2	3	3	5	4	1	18
	Total	25	25	25	25	25	20	
	Percent of the total group of 145 students answering correctly.................							52%
Item No.36	Omit	4	3	3	1	0	0	11
	*A	3	5	5	12	19	16	60
	B	4	2	2	2	0	1	11
	C	8	8	5	2	1	0	24
	D	6	7	10	8	5	3	39
	Total	25	25	25	25	25	20	
	Percent of the total group of 145 students answering correctly..................							42%
Item No.37	Omit	5	3	7	2	0	0	17
	A	10	10	9	11	4	3	47
	B	5	4	5	1	0	0	15
	*C	3	8	3	10	20	17	61
	D	2	0	1	1	1	0	5
	Total	25	25	25	25	25	20	
	Percent of the total group of 145 students answering correctly..................							42%
Item No.38	Omit	4	4	7	2	0	0	17
	A	5	3	2	3	0	0	13
	B	1	3	2	3	0	0	9
	*C	7	9	6	10	20	19	71
	D	8	6	8	7	5	1	35
	Total	25	25	25	25	25	20	
	Percent of the total group of 145 students answering correctly..................							49%

Item No. 39 Omit	4	5	6	1	0	0	16
*A	3	7	4	11	7	12	44
B	4	4	3	3	2	0	16
C	6	3	9	4	5	0	27
D	8	6	3	6	11	8	42
Total	25	25	25	25	25	20	

Percent of the total group of 145 students answering correctly.... .... 30%

Item No. 40 Omit	3	5	2	2	0	0	12
A	9	9	10	5	8	1	42
B	1	3	1	1	0	0	6
C	2	0	1	0	1	0	4
*D	10	8	11	17	16	19	81
Total	25	25	25	25	25	20	

Percent of the group of 145 students answering correctly......................... 56%

Item No. 41 Omit	3	1	1	1	1	0	7
A	3	6	1	0	0	0	10
*B	8	8	10	16	16	12	70
C	9	9	10	7	8	8	51
D	2	1	3	1	0	0	7
Total	25	25	25	25	25	20	

Percent of the group of 145 students answering correctly 49%

Item No. 42 Omit	3	2	1	3	3	0	12
A	3	8	2	1	2	0	16
*B	9	8	9	9	13	16	64
C	3	1	0	1	1	0	6
D	7	6	13	11	6	4	47
Total	25	25	25	25	25	20	

Percent of the group of 145 students answering correctly......................... 44%

Item No. 43 Omit	7	5	4	0	0	0	16
A	3	2	2	3	0	0	10
*B	2	8	8	11	22	20	71
C	5	3	1	2	1	0	12
D	8	7	10	9	2	0	36
Total	25	25	25	25	25	20	

Percent of the group of 145 students answering correctly 49%

Item No.44 Omit	7	4	2	3	0	0	16
A	6	11	11	8	3	2	41
B	5	0	2	1	0	0	8
C	3	3	3	2	0	0	11
*D	4	7	7	11	22	18	69
Total	25	25	25	25	25	20	
Percent of the group of 145 students answering correctly......................							48%
Item No.45 Omit	7	4	3	1	0	0	15
A	6	5	3	1	0	0	15
B	5	7	7	4	1	1	25
*C	3	9	12	19	24	19	86
D	4	0	0	0	0	0	24
Total	25	25	25	25	25	20	
Percent of the group of 145 students answering correctly							60%
Item No.46 Omit	5	4	3	2	0	0	14
A	4	5	1	4	1	0	15
B	11	8	6	2	3	0	30
C	4	1	1	2	1	0	9
*D	1	7	14	15	20	20	77
Total	25	25	25	25	25	20	
Percent of the group of 145 students answering correctly......................							53%
Item No.47 Omit	6	3	3	1	0	0	13
A	5	4	3	1	1	5	19
B	5	6	7	2	3	0	23
*C	6	8	10	17	21	14	76
D	3	4	2	4	0	1	14
Total	25	25	25	25	95	20	
Percent of the group of 145 students answering correctly......................							53%
Item No.48 Omit	6	4	2	1	0	0	13
A	3	5	2	0	0	0	10
B	6	4	5	0	0	0	15
C	4	2	2	0	0	0	8
*D	6	10	14	24	25	20	99
Total	25	25	25	25	25	20	
Percent of the group of 145 students answering correctly......................							69%

Item No.49	Omit	6	4	2	0	0	0	12
	A	13	8	6	1	0	0	28
	B	3	5	6	3	2	0	19
	*C	1	7	10	19	21	20	78
	D	2	1	1	2	2	0	8
	Total	25	25	25	25	26	20	

Percent of the group of 145 students answering correctly...... .... 54%

Item No.50	Omit	6	5	2	1	0	0	14
	A	3	3	5	1	1	0	13
	*B	4	8	11	18	23	20	84
	C	7	2	2	3	0	0	14
	D	5	7	5	2	1	0	20
	Total	25	25	25	25	25	20	

Percent of the group of 145 students answering correctly........................ 58%

A STUDY TO CHECK THE ATTRACTIVENESS OF THE VARIOUS DISTRACTORS OF THE MULTIPLE CHOICE QUESTIONS SET IN THE OPTIONAL PART (BIOLOGY) OF THE SCIENCE APTITUDE TEST YEAR 1967.

STUDENTS CLASSIFIED BY TOTAL TEST SCORE

Item No. 1	Omit	2	0	0	1	0	0	3
	A	1	1	0	1	0	0	3
	*B	15	20	24	21	22	10	112
	C	3	3	1	1	3	0	11
	D	4	1	0	1	0	0	6
	Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly...................... 79%

Item No. 2	Omit	0	0	0	0	0	0	0
	A	4	0	0	0	0	0	4
	*B	14	20	23	24	25	13	116
	C	2	1	0	1	0	0	4
	D	5	4	2	0	0	0	11
	Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly...................... 82%

Item No. 3	Omit	4	3	4	0	0	0	11
	*A	3	5	11	12	17	10	60
	B	3	3	2	6	4	0	18
	C	7	6	5	7	2	0	27
	D	8	8	3	0	0	0	19
	Total	25	25	25	25	25	20	

Percent of total group of 135 students answering correctly...................... 42%

Item No. 4	Omit	2	0	0	0	2	0	4
	A	1	0	1	0	0	0	2
	B	14	19	18	19	17	8	95
	*C	4	3	4	3	4	2	20
	D	4	3	2	3	2	0	14
	Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly...................... 14%

Item No.5 Omit	2	0	2	0	0	0	4
*A	9	14	17	19	22	9	90
B	7	6	4	4	0	1	22
C	4	2	1	2	3	0	12
D	3	3	1	0	0	0	7
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.................... 64%

Item No.6 Omit	1	0	0	0	0	0	1
A	0	2	3	1	0	0	6
*B	5	5	9	12	23	10	64
C	15	15	10	12	2	0	54
D	4	3	3	0	0	0	10
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.................... 45%

Item No.7 Omit	0	0	0	0	0	0	0
A	4	2	1	0	0	0	7
B	7	12	12	6	9	0	46
C	8	1	6	1	0	0	16
*D	6	10	6	18	16	10	66
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.................... 47%

Item No.8 Omit	2	0	3	0	0	0	5
A	2	5	2	0	0	0	9
*B	5	12	13	21	24	10	85
C	10	3	4	0	1	0	18
D	6	5	3	4	0	0	18
Total	25	25	25	25	25	10	

Percent of total group of 135 studens tanswering correctly........................ 60%

Item No.9 Omit	1	0	0	1	1	0	3
A	10	8	5	1	1	0	25
*B	8	9	9	17	20	10	73
C	2	4	5	1	3	0	15
D	4	4	6	5	0	0	19
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.................... 51%

Item No. 10 Omit	0	0	2	0	0	0	2
A	1	0	1	0	0	0	2
*B	13	21	19	25	25	10	113
C	7	3	3	0	0	0	13
D	4	1	0	0	0	0	5
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.................. 80%

Item No. 11 Omit	1	1	1	0	0	0	3
*A	8	17	21	20	24	10	100
B	0	2	1	1	0	0	4
C	11	1	1	2	1	0	16
D	5	4	1	2	0	0	12
Total	25	28	25	25	25	10	

Percent of total group of 135 students answering correctly.................. 70%

Item No. 12 Omit	2	3	3	2	0	0	10
A	4	4	10	2	4	0	24
B	13	2	1	0	0	0	16
*C	3	12	7	18	18	10	68
D	3	4	4	3	3	0	17
Total	25	25	25	25	25	10	

Percent of total group of 135 Students answering correctly.................. 48%

Item No. 13 Omit	2	0	0	0	0	0	2
A	4	2	3	0	0	0	6
B	1	2	2	0	0	0	5
*C	11	16	22	25	25	10	109
D	7	5	1	0	0	0	13
Total	25	22	25	25	25	10	

Percent of total group of 135 Students answering correctly.................. 75%

Item No. 14 Omit	0	0	2	0	0	0	2
A	8	7	2	4	0	0	21
*B	11	15	19	20	25	10	99
C	2	3	1	0	0	0	6
D	4	1	1	1	0	0	7
Total	25	25	25	25	25	10	

Percent of total group of 135 Students answering correctly.................. 70%

Item No. 15 Omit	0	1	1	0	0	0	2
A	5	1	3	1	2	0	12
B	3	1	2	2	0	0	8
*C	6	4	10	15	14	10	59
D	11	18	9	7	9	0	54
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly................................ 42%

Item No. 16 Omit	0	0	2	1	0	0	3
A	4	1	4	1	1	0	11
B	5	4	2	2	1	0	14
*C	3	6	8	9	12	5	43
D	13	14	9	12	11	5	46
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly................................ 30%

Item No. 17 Omit	0	0	1	1	1	0	3
A	1	3	3	3	3	1	14
*B	9	8	9	13	18	8	65
C	10	5	6	4	1	1	29
D	5	9	6	4	2	0	26
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly......— 46%

Item No. 18 Omit	1	0	0	0	1	0	2
A	5	7	15	14	15	8	64
B	12	12	10	11	8	1	54
C	5	3	0	0	0	0	8
D	2	3	0	0	1	1	7
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly................................ 45%

Item No. 19 Omit	0	0	0	0	0	0	0
*A	14	19	23	21	25	10	112
B	4	1	1	2	0	0	8
C	4	4	0	2	0	0	10
D	3	1	1	0	0	0	5
Total	25	25	25	25	25	10	

Percent of total group of 135 student answering correctly.................................... 79%

Item No. 20 Omit	0	0	1	1	0	0	2
*A	6	8	11	17	24	10	76
B	11	12	5	6	1	0	35
C	3	2	1	0	0	0	6
D	5	3	7	1	0	0	16
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.. 54%

Item No. 21 Omit	1	1	1	4	0	0	7
*A	8	12	14	17	22	10	83
B	8	3	3	2	0	0	16
C	2	4	2	1	0	0	9
D	6	5	5	1	3	0	20
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.. 58%

Item No. 22 Omit	0	0	0	0	0	0	0
A	3	0	1	0	0	0	4
B	4	3	3	0	0	0	10
C	1	0	1	0	0	0	2
*D	17	22	20	25	25	10	119
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.. 84%

Item No. 23 Omit	0	2	2	0	0	0	4
A	4	4	2	1	1	0	12
B	7	7	5	4	0	0	23
*C	8	10	19	19	22	10	81
D	6	2	4	1	2	0	15
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly.. 57%

Item No.24 Omit	1	1	2	1	3	0	8
A	7	6	2	0	1	0	16
*B	7	1	4	9	10	9	40
C	2	9	12	10	2	0	35
D	8	8	5	5	9	1	36
Total	25	25	25	25	25	10	

Percent of total group of students answering correctly............................ 28%

Item No.25 Omit	3	2	3	0	2	0	10
A	2	4	0	1	0	1	8
B	5	6	8	5	14	7	45
C	4	1	4	0	0	0	9
D	11	12	10	19	9	2	63
Total	25	25	25	25	25	10	

Percent of total group of students answring correctly............................ 32%

Item No.26 Omit	4	3	3	2	0	0	12
A	7	2	3	2	3	1	18
B	6	7	4	3	1	1	22
C	5	6	7	4	0	0	22
*D	3	7	8	14	21	8	61
Total	25	25	25	25	25	20	

Percent of total group of 135 students answering correctly........................ 43%

Item No.27 Omit	2	3	3	1	0	0	9
A	5	2	3	2	3	1	16
*B	8	10	13	16	20	9	76
C	4	2	2	3	0	0	11
D	6	8	4	3	2	0	23
Total	25	25	25	25	25	10	

Percent of the total group 135 students answering correctly..................... 54%

Item No. 28 omit	0	0	2	1	3	0	6
*A	3	8	7	14	10	9	51
B	6	5	7	6	6	1	31
C	10	7	7	4	4	0	32
D	6	5	2	0	2	0	15
Total	25	25	25	25	25	10	

Percent of total group of 135 students answering correctly 36%

Item No. 29 Omit	4	2	1	3	1	0	11
*A	15	17	16	17	22	8	95
B	2	4	2	0	1	2	11
C	3	1	5	2	0	0	11
D	1	1	1	3	1	0	7
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.............................. 67%

Item No. 30 Omit	0	0	1	0	0	0	1
A	7	2	3	3	3	0	18
B	2	7	7	4	1	2	23
*C	11	9	6	9	14	7	56
D	5	7	8	9	7	1	37
Tatal	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly 40%

Item No. 31 Omit	—	—	1	0	0	0	1
A	1	1	0	1	0	0	3
B	4	4	3	0	2	0	13
C	13	6	3	0	1	0	23
*D	7	14	18	24	22	10	95
Total	25	25	25	25	25	10	

Percent of the total group of 135 Students answering correctly............. 67%

Item No. 32	Omit	2	0	0	0	0	0	2
	*A	2	8	14	9	18	10	61
	B	14	7	7	12	4	0	44
	C	6	2	1	1	0	0	10
	D	1	8	3	3	3	0	18
	Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 43%

Item No. 33	Omit	2	2	0	0	0	0	4
	*A	11	11	12	18	23	10	85
	B	0	3	5	0	1	0	9
	C	9	3	4	3	1	0	20
	D	3	6	4	4	0	0	17
	Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 60%

Item No. 34	Omit	2	0	1	0	0	0	3
	A	2	1	3	0	0	0	6
	B	5	1	3	1	0	0	10
	C	1	9	1	1	1	0	13
	D	15	14	17	23	24	10	103
	Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 73%

tem No. 35	Omit	2	0	1	0	0	0	3
	A	5	1	1	1	0	0	8
	*B	5	11	18	20	25	10	89
	C	6	11	3	4	0	0	24
	D	7	2	2	0	0	0	11
	Total	25	25	25	25	25	25	10

Percent of the total group of 135 students answering correctly.................. 63%

Item No. 36	Omit	1	0	2	0	0	0	3
	A	6	1	1	0	0	0	8
	*B	14	19	1	25	25	10	94
	C	2	5	1	0	0	0	8
	D	2	0	20	0	0	0	22
	Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 66%

Item No. 37 Omit	3	0	2	0	0	0	5
A	1	1	1	0	0	0	3
B	2	4	0	0	0	0	0
C	4	4	0	0	0	0	8
*D	15	16	22	25	25	10	113
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly... .. .. 80%

Item No. 38 Omit	1	1	2	0	0	0	4
*A	12	20	20	24	25	10	111
B	4	4	0	0	0	0	5
C	4	1	0	0	0	0	5
D	4	2	3	1	0	0	10
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly 78%

tem No. 39 Omit	2	0	2	0	0	0	4
A	7	5	3	1	0	0	16
*B	8	14	20	23	25	10	100
C	5	3	0	0	0	0	8
D	3	3	0	1	0	0	7
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 70%

Item No. 40 Omit	1	0	1	0	0	0	2
*A	6	12	15	11	15	9	68
B	6	5	0	1	0	0	12
C	1	1	0	0	0	0	2
D	11	7	9	13	10	1	51
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 43%

Item No.41 Omit	1	0	3	0	1	0	5
A	9	12	5	10	5	1	42
*B	11	6	14	12	18	9	70
C	2	4	1	1	0	0	8
D	2	3	2	2	1	0	10
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly... .... 49%

Item No. 42 Omit	3	1	2	0	3	1	10
*A	6	5	14	14	9	2	50
B	8	3	2	1	0	0	14
C	4	10	3	4	3	0	24
D	4	6	4	6	10	7	37
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 35%

Item No- 43 Omit	3	2	5	0	3	0	13
*A	3	9	8	8	13	7	48
B	7	8	2	6	5	0	28
C	4	2	3	1	0	0	10
D	8	4	7	10	4	3	36
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.... ....39%

Item No. 44 Omit	3	2	4	0	0	0	9
*A	3	5	6	12	22	8	56
B	6	6	6	1	0	0	19
C	4	6	6	9	1	2	28
D	9	6	3	3	2	0	23
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 39%

Item No. 45 Omit	3	0	4	0	2	1	10
*A	13	10	13	15	20	9	80
B	2	4	1	1	0	0	8
C	1	6	4	2	2	0	14
D	4	4	3	7	1	0	23
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 56%

Item No. 46 Omit	2	0	3	0	1	0	6
*A	6	9	11	15	22	10	73
B	4	9	5	6	2	0	26
C	9	3	1	3	0	0	16
D	4	4	5	1	0	0	14
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly............ ... 51%

Item No. 47							
Omit	3	1	2	0	2	0	8
A	7	10	14	14	19	10	74
B	4	6	5	4	1	0	20
C	7	7	2	6	3	0	25
D	4	1	2	1	0	0	8
Total	25	25	25	25	25	10	

Per cent of the total group of 135 students answering correctly.................. 52%

Item No. 48							
Omit	2	1	2	0	0	0	5
A	7	7	6	3	12	10	45
B	4	4	3	10	7	0	28
C	5	8	9	7	6	20	35
D	7	5	5	5	0	0	22
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 32%

Item No. 49							
Omit	2	1	3	1	0	0	7
A	2	3	7	8	8	5	33
B	3	5	5	3	0	0	16
C	12	14	9	0	17	5	57
D	6	2	1	13	0	0	22
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 23%

Item No. 50							
Omit	2	2	4	1	1	0	10
A	3	4	5	0	0	0	12
B	8	14	12	23	24	10	91
C	6	2	3	0	0	0	11
D	6	3	1	1	0	0	11
Total	25	25	25	25	25	10	

Percent of the total group of 135 students answering correctly.................. 64%

A STUDY TO CHECK THE ATTRACTIVENESS OF THE VARIOUS DISTRACTORS OF THE MULTIPLE CHOISE QUESTIONS SET IN THE OPTIONAL PART (CHEMISTRY) OF THE SCIENCE APTITUDE TEST YEAR 1967·

STUDENTS CLASSIFIED BY LOTAL TEST SCORE

	Responses	Lowest	Next lowest	Middle		Next highest	Highest	Total
		0–20	21-40	41-60	61-80	81-100	101-120	
Item No. 1	Omit	2	1	0	0	0	0	3
	A	7	4	1	1	0	0	13
	B	4	1	0	0	0	0	5
	C	2	8	2	0	0	0	12
	*D	14	21	21	38	30	30	154
	Total	29	35	24	39	30	30	187
Percent of the total group of 187 students answering correctly...... ....82%								
Item No. 2	Omitt	0	2	0	3	1	2	8
	*A	8	9	4	13	6	22	62
	B	9	11	13	13	14	4	64
	C	6	6	4	8	7	0	31
	D	6	7	3	2	2	2	22
	Total	28	35	24	39	30	30	187
Persent of tha total group of 187 students answering correctly........................33%								
tem No. 3	Omitt	3	5	1	3	3	0	15
	A	2	1	4	0	2	1	10
	B	7	17	10	12	4	0	50
	C	15	8	4	4	1	0	32
	*D	2	4	5	20	20	29	80
	Total	29	35	24	3/	30	30	187
Percent of the total group of 187 students answering correctly.................. 43%								
Item No. 4	Omitt	1	4	0	2	1	1	9
	*A	13	16	15	18	10	20	92
	B	1	4	3	9	6	1	24
	C	11	5	6	2	1	0	25
	D	3	6	0	8	12	8	37
	Total	29	35	24	39	30	32	187
Percent of the total group of 187 students answering correctly.................. 49%								

Item No.	5 Omit	0	1	0	1	0	0	2
	A	5	5	6	3	2	1	22
	B	5	12	1	2	2	0	22
	C	7	5	1	0	0	0	13
	*D	12	12	16	33	26	29	128
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 68%

Item No.	6 Omit	0	0	0	3	1	0	4
	A	3	1	0	3	1	0	8
	B	8	10	7	3	1	0	29
	*C	12	16	7	11	19	25	90
	D	6	8	10	19	8	5	56
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 48%

Item No.	7 Omit	0	0	0	0	0	0	0
	A	8	9	1	0	0	0	18
	B	14	9	7	4	3	1	38
	*C	5	12	13	31	27	29	117
	D	2	5	3	4	0	0	14
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 62%

Item No.	8 Omit	1	0	0	0	0	0	1
	A	7	8	7	3	2	0	27
	*B	8	21	16	36	28	30	139
	C	6	4	1	0	0	0	11
	D	7	2	0	0	0	2	9
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 stndents answering correctly.................. 74%

Item No.	9 Omit	1	3	0	1	0	1	6
	A	6	4	2	2	0	0	14
	B	2	2	2	0	2	0	8
	*C	18	23	19	35	28	28	151
	D	2	3	1	1	0	1	8
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 81%

Item No. 10	Omit	1	0	0	0	0	0	1
	A	6	8	4	3	2	2	25
	B	7	6	2	2	0	0	17
	C	8	7	4	4	2	1	26
	*D	7	14	14	30	26	27	118
	Total	29	35	24	39	30	30	187
Percent of the total group of 187 students answering correctly.................								63%
Item No. 11	Omit	0	0	0	0	9	0	4
	A	11	10	10	11	5	3	59
	*B	5	14	5	19	19	27	89
	C	5	3	2	4	2	0	16
	D	8	8	7	5	4	0	32
	Total	29	35	24	39	30	30	187
Percent of the total group of 187 students answering correctly..								47%
Item No. 12	Omit	1	0	0	0	1	0	2
	A	2	1	0	1	0	0	4
	*B	11	24	16	32	27	30	140
	C	1	1	0	1	1	0	4
	D	14	9	8	5	1	0	37
	Total	29	35	24	39	39	30	187
Percent of the total group of 187 students answering correctly.								75%
Item No. 13	Omit	1	1	0	0	0	0	2
	*A	5	15	12	36	27	29	124
	B	3	7	0	0	1	1	12
	C	6	3	7	2	1	0	19
	D	14	9	5	1	1	0	30
	Total	29	35	24	39	30	30	187
Percent of the Total group of 187 students answering correctly..............								66%
Item No. 14	Omit	2	4	1	1	0	0	8
	A	7	6	5	6	2	0	26
	*B	5	5	3	14	20	25	72
	C	11	8	4	2	4	0	29
	D	4	12	11	16	4	5	52
	Total	29	35	24	39	30	30	187
Percent of the total group of 187 students answering correctly..............								38%

Item No. 15	Omit	1	1	0	0	0	0	2
	A	9	9	10	7	2	0	37
	B	4	3	0	0	0	0	7
	*C	8	19	13	23	23	28	114
	D	7	3	1	9	5	2	27
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 61%

Item No. 16	Omit	0	4	1	2	0	1	8
	A	13	8	7	13	7	4	52
	B	3	8	4	5	4	3	27
	C	8	6	5	7	7	1	34
	*D	5	9	7	12	12	21	66
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.............. ... 35%

Item No. 17	Omit	1	4	0	2	1	0	8
	A	8	2	1	2	0	0	13
	*B	10	21	16	32	28	28	135
	C	7	7	4	2	1	1	22
	D	3	1	3	1	0	1	9
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly 72%

Item No. 18	Omit	0	2	0	1	0	0	3
	A	11	6	2	2	1	0	22
	B	3	6	6	6	1	0	22
	*C	10	20	14	30	27	30	131
	D	5	1	2	0	1	0	9
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 70%

Item No. 19	Omit	4	3	2	1	2	0	12
	A	12	9	6	5	3	0	35
	B	3	8	10	6	3	6	36
	*C	3	8	2	22	18	21	74
	D	7	7	4	5	4	3	30
	Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 44%

Item No. 20 Omit	2	2	1	2	0	0	7
A	4	9	7	0	1	0	21
B	9	3	0	1	0	0	13
*C	10	15	13	32	28	30	128
D	4	6	3	4	1	0	18
Total	29	35	24	39	30	30	187

Percent of the total group of 137 students answering correctly.................... 68%

Item No. 21 Omit	2	4	2	2	0	0	10
A	4	2	0	3	1	0	10
*B	9	12	9	15	20	29	94
C	9	13	11	19	8	0	60
D	5	4	2	0	1	1	13
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 50%

Item No. 22 Omit	0	3	0	0	0	0	5
*A	5	19	11	30	0	0	65
B	7	2	2	0	2	0	13
C	4	1	2	1	26	29	63
D	13	10	9	8	2	1	43
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 35%

Item No. 23 Omit	2	3	0	0	0	0	5
A	6	4	2	0	0	0	12
B	6	4	4	15	1	0	30
C	9	9	2	4	0	0	24
*D	6	15	16	20	29	30	116
Total	29	35	24	39	30	30	187

Precent of the total group of 187 students answering correctly.................. 62%

Item No. 24 Omit	1	4	0	0	0	1	6
A	4	7	5	4	2	3	25
*B	3	9	8	16	12	10	58
C	7	7	8	16	10	13	61
D	14	8	3	3	6	3	37
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 31%

Item No. 25 Omit.	3	4	1	2	0	1	11
A	6	7	7	8	3	1	33
B	5	2	1	0	0	0	8
*C	8	13	1	23	24	25	94
D	7	9	14	6	3	2	41
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly... .... 50%

Item No. 26 Omit.	1	5	0	1	0	2	9
A	2	5	5	6	1	0	19
B	11	17	8	14	8	5	63
C	6	1	4	2	2	1	16
*D	9	7	7	16	19	22	80
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 43%

Item No. 27 Omit.	3	5	1	2	1	0	12
A	9	11	10	7	7	1	45
B	5	7	6	11	5	0	34
*C	6	9	3	16	16	29	79
D	6	3	4	3	1	0	17
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly 42%

Item No. 28 Omit.	4	4	1	1	0	0	10
*A	6	5	10	21	23	25	90
B	8	13	6	12	6	5	50
C	4	6	1	1	0	0	12
D	7	7	6	4	1	0	25
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly... .... 48%

Item No. 29 Omit.	1	3	2	2	1	0	9
A	1	9	3	1	1	0	15
*B	14	15	15	29	25	30	128
C	10	6	2	7	2	0	27
D	3	2	2	0	1	0	8
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly 68%

Item No. 30 Omit.	0	2	2	1	0	0	5
A	7	3	2	1	0	0	13
B	6	4	2	0	2	0	14
*C	12	26	18	37	27	30	150
D	4	0	0	0	1	0	5
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 80%

Item No. 31 Omit.	1	1	1	0	0	1	4
A	4	3	0	0	0	0	7
*B	12	23	23	38	30	29	155
C	9	2	0	1	0	0	12
D	3	6	0	0	0	0	9
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 83%

Item No. 32 Omit.	0	1	1	0	0	1	3
*A	18	31	23	38	30	29	169
B	4	1	0	1	0	0	6
C	5	1	0	0	0	0	6
D	2	1	0	0	0	0	3
Totat	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.. .... 90%

Item No. 33 Omit.	2	3	1	0	0	0	6
A	4	3	0	0	0	0	7
B	7	6	3	0	0	0	16
*C	12	20	20	38	30	30	150
D	4	3	0	1	0	0	8
Total	29	35	24	39	30	30	187

Precent of the total group of 187 students answering correctly.................. 80%

Item No. 34 Omit.	2	3	2	0	0	0	7
A	6	9	4	9	12	7	47
B	4	4	5	6	3	5	27
*C	14	16	11	15	13	12	81
D	3	3	2	9	2	6	25
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 43%

Item No. 35 Omit.	3	3	1	0	0	0	7
A	4	3	0	5	1	0	13
B	0	0	0	3	2	0	5
*C	14	23	20	30	27	30	144
D	8	6	3	1	0	0	18
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 77%

Item No. 36 Omit.	1	7	1	0	0	0	9
A	7	3	2	0	0	0	12
*B	9	12	20	37	27	29	134
C	6	7	0	1	2	0	16
D	6	6	1	1	1	1	16
Total	29	35	24	39	39	30	187

Percent of the total group of 187 students answering correctly............ ..... 72%

Item No. 37 Omit	3	6	4	0	1	1	15
A	7	8	9	5	3	0	32
*B	5	12	7	32	25	29	110
C	8	3	1	0	0	0	12
D	6	6	3	2	1	0	18
Total	29	35	24	39	30	30	187

Percent of the total Group of 187 students answering correctly.................. 59%

Item No. 38 Omit	2	7	1	1	2	1	14
A	9	12	8	4	2	0	35
*B	13	14	14	31	26	29	127
C	2	0	0	0	0	0	2
D	3	2	1	3	0	0	9
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 68%

Item No. 39 Omit	3	7	4	1	2	0	17
*A	0	4	4	18	14	28	68
B	6	4	5	2	3	1	21
C	15	15	10	17	11	1	69
D	5	5	1	1	0	0	12
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 36%

Item No. 40 Omit	1	5	3	2	2	1	14
*A	10	7	6	17	17	22	79
B	11	14	7	4	6	1	43
C	3	5	4	6	2	2	22
D	4	4	4	10	3	4	29
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 42%

Item No. 41 Omit	0	5	3	0	0	0	8
A	9	10	4	4	0	0	27
*B	6	5	13	30	27	30	111
C	4	8	3	2	3	0	20
D	10	7	1	3	0	0	21
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering cotrectly.................. 59%

Item No. 42 Omit	0	4	3	0	0	0	7
*A	7	13	12	34	28	30	124
B	7	2	1	1	1	0	12
C	8	11	7	0	0	0	26
D	7	5	1	4	1	0	18
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 66%

Item No. 43 Omit	1	7	3	1	0	0	12
A	6	6	4	2	2	0	20
B	7	2	0	0	0	0	9
C	6	3	1	2	0	0	15
*D	6	17	16	34	28	30	131
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 70%

Item No. 44 Omit	0	10	3	1	0	0	14
A	15	9	4	6	0	0	34
*B	1	8	9	24	28	30	100
C	6	2	3	1	0	0	12
D	7	6	5	7	2	0	27
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 53%

Item No. 45 Omit	10	10	4	1	0	0	25
A	6	4	3	0	2	0	15
*B	4	15	13	35	28	30	125
C	2	4	3	1	0	0	9
D	7	2	2	2	0	0	13
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.............. 67 %

Item No. 46 Omit	2	10	3	1	1	0	17
A	4	6	2	0	1	0	13
B	6	6	4	13	4	4	37
*C	9	10	13	21	23	24	18
D	8	3	2	4	1	2	20
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 53%

Item No. 47 Omit	2	8	2	8	5	2	22
A	8	5	5	8	4	0	30
B	2	5	4	14	9	13	47
C	9	7	4	6	11	15	52
D	8	10	9	0	1	0	36
Total	29.	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly............. ... 28%

Item No. 48 Omit	0	8	3	2	5	0	18
A	4	2	2	2	0	0	10
B	5	7	3	3	1	0	19
*C	19	15	13	31	24	30	132
D	1	3	3	1	0	0	8
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................. 70%

Item No. 49 Omit	0	8	3	1	2	0	14
*A	13	18	16	34	27	30	138
B	7	4	1	2	1	0	5
C	8	2	2	0	0	0	12
D	1	8	2	2	0	0	8
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................... 74%

Item No. 50 Omit	0	7	2	0	2	0	11
A	12	20	14	33	28	30	137
B	7	4	0	1	0	0	12
*C	3	2	5	5	0	0	15
D	7	2	3	0	0	0	12
Total	29	35	24	39	30	30	187

Percent of the total group of 187 students answering correctly.................... 73%

STUDY NO. 8

A CRITICAL AND CORRELATIVE STUDY OF THE N.S.T.S. EXAMINATION 1967 AND THE SCHOOLWISE DATA OF SCHOOLS IN DELHI.

Ved Ratna,

Acknowledgement :—Thanks are due to Dr. D.S. Kothari, Chairman, University Grants Commission and to Dr. K.N. Saxena, Field Adviser in my office for their encouragement and guidance in conducting this study and to Shri Pushpendra Kumar of my office for helping me in the statistical work connected with the preparation of this paper.

The National Science Talent Search Scheme is being operated by the NCERT for almost 5 years now. The two chief purposes of this scheme are :—

1. To locate promising students who can be considered potential scientists early at the secondary stage, and

2. To nurture the talent of these students so that their creative powers develop in the best possible way. Thus this scheme is intended to ultimately become a perpetual and rich source of brilliant scientists to our country.

To meet the first of these purposes the selection of students studying in class XI (or equivalent) is done in three stages :

1. Only those students who have secured 55% or more marks in science subjects in their annual examination of class X are allowed to appear at an All-India examination.

2. In the examination, which is held on the first Sunday in the month of January, the examinees take an objective type "Science Aptitude Test", write an "Essay", and submit a "Project Report" written by them earlier on some experimental or theoretical work of scientific nature done by them. On the basis of their score in these three tests about 1200 students are called for interview.

3. After the students appear in the interview about 350 students are selected for the award of scholarship on the basis of their total score in the theory test and interview. The scholars are awarded w.e.f. the month of July.

Since the selection of right type of students is the backbone of the whole scheme, a constant evaluation of the technique of selection is extremely essential. The above described technique is intended to assess the pupils' :

*aptitude for science,

*powers of scientific reasoning, critical thinking and skill in scientific experimentation,

*ability to apply knowledge to analyse and interpret scientfiic data,

*ability to express scientific concepts clearly and precisely,

*creativeness and mental alertness in the investigation of scientific phenomena,

*knowledge about the recent developments in the various branches of pure and applied sciences, and skill to devise and develop some original ideas experimentally.

Although the ultimate criterion of the success of the whole scheme with reference to both the purposes mentioned above will only be the work that will be done by the awardees of this scholarship when they enter their career as fullfleged scientists, continuous effort is made by the N.C.E.R.T. to evaluate the existing technique of selection. In this respect, various kinds of statistical study are done every year on the data obtained from the N.S.T.S. examination and published in the form of a report. In continuation of this process need was felt for a study of the variation in the performance of students at the N.S.T.S. examination from one school to another.

It was desired in this study to eliminate the general differences of educational standards and social environment that may exist between one state and another. Thus the Union Territory of Delhi was chosen for this study, just as a matter of convenience.

Data was collected for the following three distinct Examinations :

(1) Higher Secondary Examination, 1967 conducted by the Central Board of Secondary Education, Indraprastha Estate, New Delhi-1.

(2) All India Higher Secondary Examination, 1967 conducted by the Central Board of Secondary Education, Indraprastha Estate, New Delhi-1.

(3) Indian School Certificate Examination, Dec., 1966 conducted by the Council for the Indian School Certificate Examination, B-27, Nizamuddin East, New Delhi-13.